MARCH, 1934

METALS & ALLOYS

The Magazine of Metallurgical Engineering

PRODUCTION · FABRICATION · TREATMENT · APPLICATION

Current Metallurgical Abstracts

Long-lasting containers . .

During the past few years ENDURO, Republic's Perfected Stainless Steel, has proved itself the ideal material for containers of every kind—vats, tanks, trays, kettles and similar industrial equipment.

The advisability of using ENDURO becomes more and more apparent as time goes on, especially where the liquids stored or processed are of a corrosive nature, where they must be kept free from contamination, or where contact with other material might produce a change in chemical content or in taste in the case of dairy, brewery and other food products.

ENDURO is a chromium-nickel steel—the same long-lasting alloy all the way through. It fabricates easily—can be cut, bent, formed and punched without difficulty—and can be welded by any of the accepted production methods except forge welding. The use of ENDURO welding rod enables the fabricator to produce equipment that has the same resistance to corrosion throughout the finished piece. And for convenience and economy ENDURO is available in all commercial forms and in a variety of finishes.

If you are interested, as a user or a fabricator, write today for complete information.

Inset above: 125-gallon steam jacketed kettle made of ENDURO *by Lee Metal Products Company, Inc., Philipsburg, Pa.*

In oval: *Eighteen 500-gallon milk tanks made of* ENDURO *by Lee Metal Products Company, Inc., Philipsburg, Pa.*

At right: *Laundry truck tub made of* ENDURO *by Ellis Drier Co., Chicago, Ill.*

ENDURO
REPUBLIC'S PERFECTED STAINLESS AND HEAT-RESISTING STEELS

Licensed under Chemical Foundation Patents Nos. 1316817 and 1339378.

CENTRAL ALLOY DIVISION • • MASSILLON, OHIO
REPUBLIC STEEL CORPORATION
GENERAL OFFICES — YOUNGSTOWN, OHIO

Metals & Alloys, published monthly by The Chemical Catalog Company, Inc. Publication office: 1117 Wolfendale St., Pittsburgh, Pa. Executive offices: 330 West 42nd St., New York, N. Y. Entered as second class matter March 14, 1932, at the Post Office at Pittsburgh, Pa., under the Act of March 3, 1879. $3.00 a year in U. S.; foreign, $8.00. Vol. 5, No. 3.

METALS & ALLOYS

The Magazine of Metallurgical Engineering

devoted to

Production — Fabrication — Treatment — Application

PUBLICATION OFFICE:
1117 Wolfendale St., Pittsburgh, Pa.

H. W. GILLETT, Editorial Director
Battelle Memorial Institute,
Columbus, Ohio

RICHARD RIMBACH, Editor

WM. P. WINSOR, Advertising Manager

EDITORIAL AND ADVERTISING OFFICES:
330 West 42nd St., New York, N. Y.

BRANCH OFFICE:
706 Straus Bldg., Chicago, Ill.
G. E. Cochran   R. M. Creaghead

PUBLISHED MONTHLY BY
THE CHEMICAL CATALOG COMPANY, INC.

Ralph Reinhold, Pres.-Treas.
Philip H. Hubbard, Vice-Pres.
H. Burton Lowe, Vice-Pres.
Francis M. Turner, Vice-Pres.

Annual Subscription: U. S., Possessions; $3.00; Canada, $4.00; All Other Countries, $8.00 (Remit by New York Draft). All communications relating to subscriptions or back issues should be addressed to METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

Entered as second-class matter March 14, 1932, at the post office at Pittsburgh, Pa., under the Act of March 3, 1879.

CONTENTS · MARCH, 1934

CURRENT METALLURGICAL ABSTRACTS

HIGHLIGHTS

by H. W. GILLETT

DO YOU want to know what metallurgical engineers are saying, the world over? Look in the Current Metallurgical Abstracts. Here are some of the points covered by authors whose articles are abstracted in this issue.

Lubrication in Drawing and Stamping

Writers of articles abstracted in Sec. 12h (page MA 102 R 2, 6, 10 and page MA 103 L 1, 3, 4), Drawing and Stamping, are giving much consideration to lubrication in wire drawing and deep stamping. Lead coatings, soaps, oils, greases and various other organic lubricants are discussed. Mai points out that grease-drawn wire for nails carries enough grease worked into the surface of the nail to give appreciable corrosion resistance over that drawn with soap.

Testing Welds

Block & Ellinghaus (page MA 95 R 6) favor a free bend test for welds instead of bending over a mandrel. *Commonwealth Engineer* (page MA 96 R 4) urges an impact test and also (page MA 96 L 1) cites a German method of cutting an oval hole in the weld deep etching it and later filling the hole. Pfaffenberger (page MA 96 R 1) praises magnetic test methods.

High Carbon—High Chrome Die Steels

According to Murakami & Hatta (page MA 78 R 3) high carbon high chromium die steels show variable critical temperatures on cooling according to the temperature of heating. (This "T max." effect is, of course, well known in tungsten steels.) For maximum hardness the steels should be heated to 1000° C. before quenching.

Reverse Direction of Pull to Prevent Cuppy Wire

Saxton (page MA 102 R 5) advises reversing the direction of pull in wire drawing to reduce preferred orientation of the crystals and prevent overdrawing to cuppy wire.

Properties of Manganese-Molybdenum and Nickel-Chrome-Molybdenum Cast Steels

Kesper (page MA 78 R 7) records data on water quenched and tempered MnMo and air hardened and tempered NiCrMo cast steels respectively showing, tensile 100,000, 115,000, yield 75,000, 85,000, reduction 60, 40, elongation 26, 20.

Growth of Cast Iron

Schmid (page MA 112 R 9) thinks that very high Mn content is desirable in ingot mold iron and irons for general resistance to growth at high temperatures.

Flotation

Flotation theories and practice are discussed in U. S., Canadian, German and Russian periodicals (page MA 114). It works, but just why and how is still pretty much of a mystery.

Paint Tests

According to Peters (page MA 113 R 9) present German methods of testing paints for behavior as rust preventers give the wrong answer in one case out of every three. Mecke (page MA 114 L 1) tries black rust preventive coatings (tar, etc.) on white mice—internally, not externally.

Machining

Seventeen out of 24 abstracts under machining (pages MA 101 & MA 102) deal with the tungsten carbide type of tool.

Thermal Conductivity and Cracks

Franke (page MA 105 R 9) alleges that thermal conductivity can be used to show presence of slag or cracks. He heats a spot with a blow torch and notes, by thermocouples, the rate of heating at places equally distant from that spot.

Slag

Giolitti (page MA 105 R 5) questions the idea that non-metallic slag is soluble in liquid steel and precipitates out on freezing. He explains apparent metallographic exidence that has been so interpreted by the hypothesis that submicroscopic emulsified particles agglomerate on freezing.

Corrosion and Wear Resistance of Aluminum Coatings

According to Pullen (page MA 105 L 2) the corrosion resistance and wear resistance of anodic coatings on Al produced in chromic, sulphuric or oxalic acid baths are so much alike that no preference can be given any one of the three processes.

Abstract Classifications Rearranged

Beginning with the next issue of *Metals & Alloys,* the current Metallurgical Abstracts will appear in a new arrangement. As a rule changes are not justified unless certain advantages accrue.

The new arrangement of classifications will be in the order in which the materials are processed in the metallurgical industries. Beginning with the ore after it has been taken from the mine, the classifications pass through the concentration and reduction of the ore, the melting and working of the metals, their treatment, fabrication and finishing; finally the testing and properties and applications of metals and alloys.

Editorial Comment

Misapprehensions

Some metallurgical misapprehensions are difficult to eradicate. Any superstition dies hard. Some of the metallurgical superstitions that crop up every so often are in connection with "hardened copper," "crystallization" under repeated stress, modulus of elasticity, and thermal conductivity.

Of these, the myth as to the "lost art of hardening copper" seems to be dying a natural death with the advent of information on the strong heat-treatable copper alloys such as those with beryllium or with nickel silicide, for the metallurgist and engineer know that these alloys were not available to the ancients and that the precipitation-hardening phenomena involved are matters of very recent development. So while the Sunday Supplement reporter may still break loose on hardened copper again, even there the tendency is for some semblance of scientific checking-up on such stories and any attempt at getting such a check should straighten the reporter out.

"Crystallization" under repeated stress is harder to down. Metallurgists all know that this phraseology is wrong and misleading, but there still are engineers and even some editors of non-metallurgical engineering journals who are careless about phraseology and slip up now and then. The garage-man is still very prone to use the phrase and thus the general non-engineering public remains misled. But this situation is steadily improving on the whole.

While it seldom gets into print, it is astonishing how many people have been given to understand by salesmen that this or that alloy steel has a very much higher modulus of elasticity than carbon steel. Almost any metallurgist can cite cases where he has had a hard time to convince some engineer, who does not regularly have to consider the properties of steel products, that such claims are hooey.

But the queerest misapprehension which both metallurgists and engineers seem to fall into relate to thermal conductivity and other thermal properties. At a meeting of one of the oldest engineering societies a short time back, according to the reports of the meeting, there was interjected into the discussion by the promoter of a direct reduction process for iron ore, amid other general claims that directly reduced iron is good for what may ail steel, the statement that steel made from such raw material has high thermal conductivity. None of the engineers and metallurgists at the session saw fit to enter any protest or raise any question about a claim so absurd, but apparently accepted the statement.

Similarly, one often finds claims made for high thermal conductivity of some copper alloys that actually have about the thermal conductivity of cast iron. In the mind of the engineer aluminum alloys are often erroneously credited with having thermal conductivity like that of the pure metal. Even aluminum itself is often overrated where heat storage is involved because its high specific heat is offset by its low density. Such misapprehensions are often of no moment because of an even greater misapprehension as to the role of the thermal conductivity of metals in many problems of heat transfer. As Van Dusen points out[1] other thermal resistances in the system are so often so vastly greater than that of the metal parts that it is of no moment what metal or alloy is used, and a slip in the appraisal of the conductivity of the metal chosen doesn't affect the performance. Often a cheaper metal would have served equally as well, however.

There are cases where thermal conductivity does count and count heavily. Designers of core ovens, heat-treating furnaces, and the like are coming to avoid "through metal" that affords a direct path for conduction of heat from the hot zone to the outside air without interposition of heat-insulation. In commercial practice avoidance of thermal conductivity is more common than its utilization. On the other hand, interesting cases of utilization are not lacking.

It has been found[2] that slight local temperature variations affect the performance of a standard cell, so they are now being provided with copper-lined cases to improve temperature uniformity by virtue of the thermal conductivity of copper.

Similarly, a silver lining, or one of chromium-plated copper for temperatures too high for silver, in a furnace used for creep testing at high temperatures, vastly improves[3] the temperature uniformity over the test length of the specimen.

One of the most interesting industrial applications of the thermal conductivity of copper has been described by Schmid.[4] A pile of thin steel sheets that actually touch each other at few points and hence have insulating air spaces between them is difficult to drive heat through. Annealing such packs is a rather slow process. Raising the rate of heat input involves danger of overheating the edges and only a moderate input can be stood without producing too great differences in the properties of the annealed sheets at the edges and the center. Schmid

(Continued on page 60)

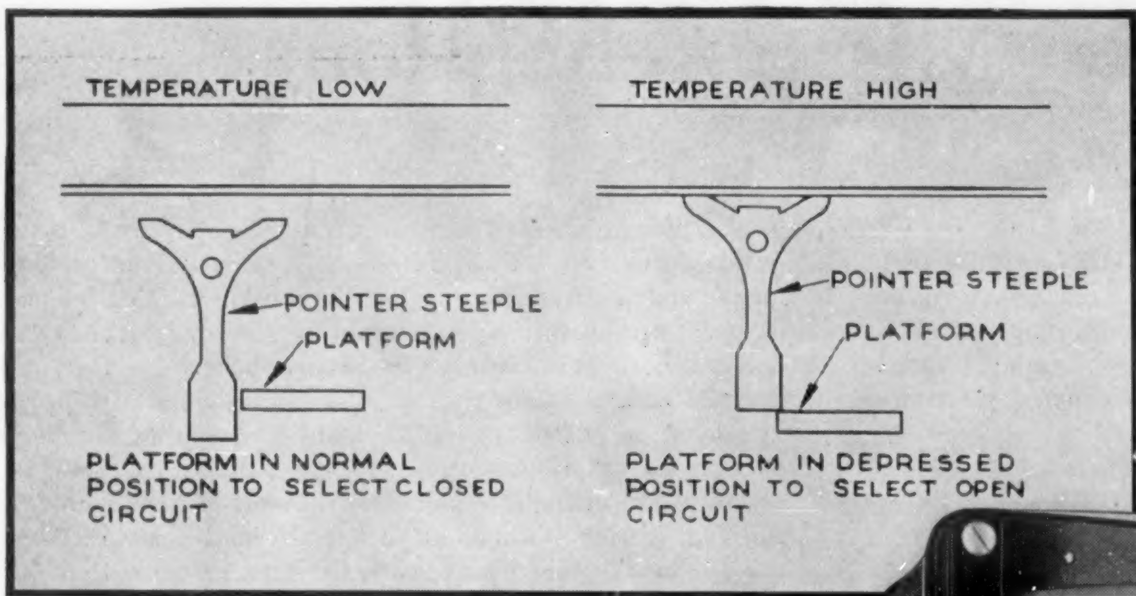
[1]M. S. Van Dusen. Note on Applications of Data on the Thermal Conductivity of Metals. *Symposium on Effect of Temperature on Metals, A.S.T.M.-A.S.M.E.*, 1931, pages 725-729.

[2]J. H. Park. Effect of Service Temperature Conditions on the E.M.F. of Unsaturated Portable Standard Cells. *Bureau of Standards, Journal of Research*, Vol. 10, Jan. 1933, pages 89-98.

[3]H. W. Gillett & H. C. Cross. Obtaining Reliable Values for Creep of Metals at High Temperatures. *Metals & Alloys*, Vol. 4, July 1933, pages 91-98, 104.

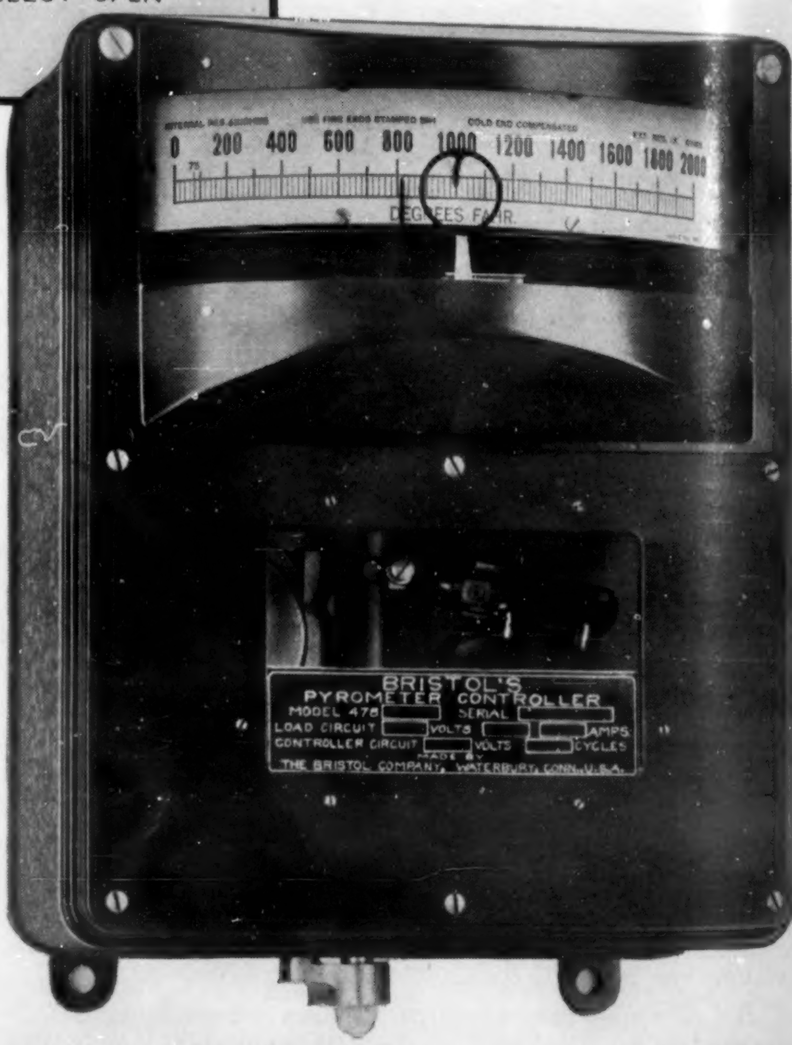
[4]H. Schmid. Uber wärme technische Vorgänge beim Glühen von Bandeisen in Ringform. Dissertation, Technische Hochschule, Aachen, Feb. 27, 1933, 33 pages.

Pyrometer Pointer Action Stabilized at control point



Left: Sketch, showing how "shear-edge" action of pointer platform mechanism assures fractional degree control accuracy.

Below: BRISTOL'S New Pyrometer Controller, Model 478, with self-contained mercury switches, for ranges up to 3000° F.



THIS new BRISTOL'S Model 478 Pyrometer Controller is so designed that the action of the pointer is stabilized at the control temperature. Here you will find no erratic pointer action which is so annoying in effecting precision control.

There are several other features. Note, in particular, (a) clean, non-arcing, non-oxidizing, non-corroding mercury-to-mercury electric contacts, sealed in glass; (b) no need for relays; (c) operating mechanism always visible; (d) accessibility of telechron motor, mercury switches and terminal block, simplifying field inspection without exposing control mechanism to dirt, fumes or misalignment; (d) full safety features; (e) simple and rugged working parts.

Write for Bulletin 389.

THE BRISTOL COMPANY, WATERBURY, CONN.
Branch Offices: Akron, Birmingham, Boston, Chicago, Denver, Detroit, Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco

BRISTOL'S CONTROL MAKES GOOD!

Since BRISTOL'S makes both control instruments and automatic valves, BRISTOL is in the favorable position of being able to develop the complete control system as a unit. It has the facilities correctly to engineer the desired system in order to achieve practical successful results.

TRADE MARK
BRISTOL'S
REG. U. S. PAT. OFF.

PIONEERS IN PROCESS CONTROL SINCE 1889

Manufacture of Rimmed Steel Ingots*

By J. H. Nead† and T. S. Washburn†

THE OBJECT of this paper is to present some of the factors which have been found to affect the quality of rimmed steel ingots. Rimmed steel, as it is generally known in the trade, is one which is not deoxidized, or only partially deoxidized, prior to pouring into the molds. Consequently, a reaction occurs between the free oxides, of which iron oxide is probably the principal one, and the carbon in the metal during the first part of the solidification period. This reaction results in the partial elimination of oxygen and carbon, due to the fact that a large part of the gas which is formed from these two elements rises and passes out at the top of the solidifying ingot. This gas, together with others such as hydrogen and nitrogen that come out of solution during the cooling and solidification of the metal, causes a boiling action which keeps the top of the ingot open during the first part of the solidification period—the metal solidifying from the mold sides and forming a gradually increasing rim which comes together at the center. This rimming action is not usually allowed to progress to completion, however, as it has been found that a more satisfactory ingot is obtained by placing a "cap" consisting of a plate or cast iron block on the ingot top before the rimming action is finished, thus chilling the liquid center at the top and preventing the further elimination of gas.

The quality of rimmed steel ingots is determined by their composition, degree of segregation, internal structure, and the condition of the surface. One of the most severe applications of rimmed steel ingots is in the production of deep drawing sheets and strips, and the present paper will be limited to a discussion of the method of production and quality of ingots to be used for this purpose.

The ladle analysis range that has been found to be the most satisfactory for deep drawing steel is as follows:

carbon	manganese	phosphorus	sulphur
0.07-0.10%	0.35-0.45%	0.015% max.	0.030% max.

The average composition of the ingots will be approximately 0.03% lower in carbon, due to the loss of this element during rimming. The phosphorus will normally be under 0.010%, and it is desirable to have the sulphur under 0.025%.

The degree of segregation, surface condition, and internal structure are affected by a number of factors in the furnace and pouring practice. Some of these factors will be discussed in the order in which they occur in the open hearth process.

In general, it has been found that a clean scrap charge gives the best quality steel. By this is meant a charge composed of heavy and light melting mill scrap, as compared to automobile, detinned, and miscellaneous scrap. The detrimental effect of the latter grades is not always noted, but the observation of a large number of heats shows them to be associated with poorer quality steel; with respect to both surface and drawing properties.

*Condensed by the authors from a report presented at the 1933 Open Hearth Conference.

†Chief Metallurgist & Metallurgist, respectively, Inland Steel Company.

In regard to the form of lime used, it has been found that limestone gives better results than burnt lime in the charge. A comparison of steel made from the two types of lime charge shows no appreciable difference in the open hearth or rolling mills, but steel from burnt lime heats appears to be more subject to laminations.

The effect of the quality of the iron on that of the finished steel is rather indeterminate. A satisfactory working range is as follows: 0.75 to 1.35% silicon; 1.50 to 2.50% manganese; .150 to .250% phosphorus; and .040% max. sulphur. It has been found that the best results are obtained when the furnaces are not fluctuating much within this range, and also it is desirable to have the sulphur as low as practicable—preferably under 0.030%.

The percentage of lime used in the charge depends on the amount of silicon in the iron and scrap, and on the iron oxide content desired in the finishing slag. The following table shows the relation that has been found between the lime-silica slag ratio, and the iron oxide (ferrous oxide) in the slag, for two carbon ranges of steel:

CaO/SiO_2	FeO in .05-.07% C heats	FeO in .08-.12% C heats
2.8	14.0	10.5
3.0	17.0	12.5
3.2	19.5	14.0
3.4	22.0	16.0
3.6	24.0	17.5

This table shows that as the ratio of lime to silica, or the basicity increases, there is an increase in the iron oxide content of the slag; and that for a given basicity, the lower the carbon content of the bath the higher is the iron oxide content of the slag. A similar relation, of course, exists between the lime-silica ratio computed from the lime and silicon in the charge. The values for this ratio are greater than the slag ratio, varying from 3.9 up to 4.8 for the range of iron oxides given above. The reason for this discrepancy is that the silicon in the scrap is not included when computing the charge ratio.

In practice it has been found in one shop that the most satisfactory rimming action is obtained when the iron oxide content of the slag is between 17 and 21%. This range is maintained in .07 to .10% carbon heats by holding the lime-silica ratio of the slag between 3.0 and 3.3%. The lime charge required in order to keep within this range is 9.5%. It should be noted in connection with the above data that it has been compiled from the results of a large number of heats and that many variations occur when individual heats are considered due to fluctuation from equilibrium conditions and the effect of other variables.

After the heat has been worked down to the carbon content desired, a satisfactory practice on deep drawing steel is to add spiegel to the bath and tap approximately 30 minutes after this addition. The purpose of the spiegel is to equalize the temperature of the bath and flux out some of the impurities that may be present. Ferro-manganese is added to the ladle to meet the specification.

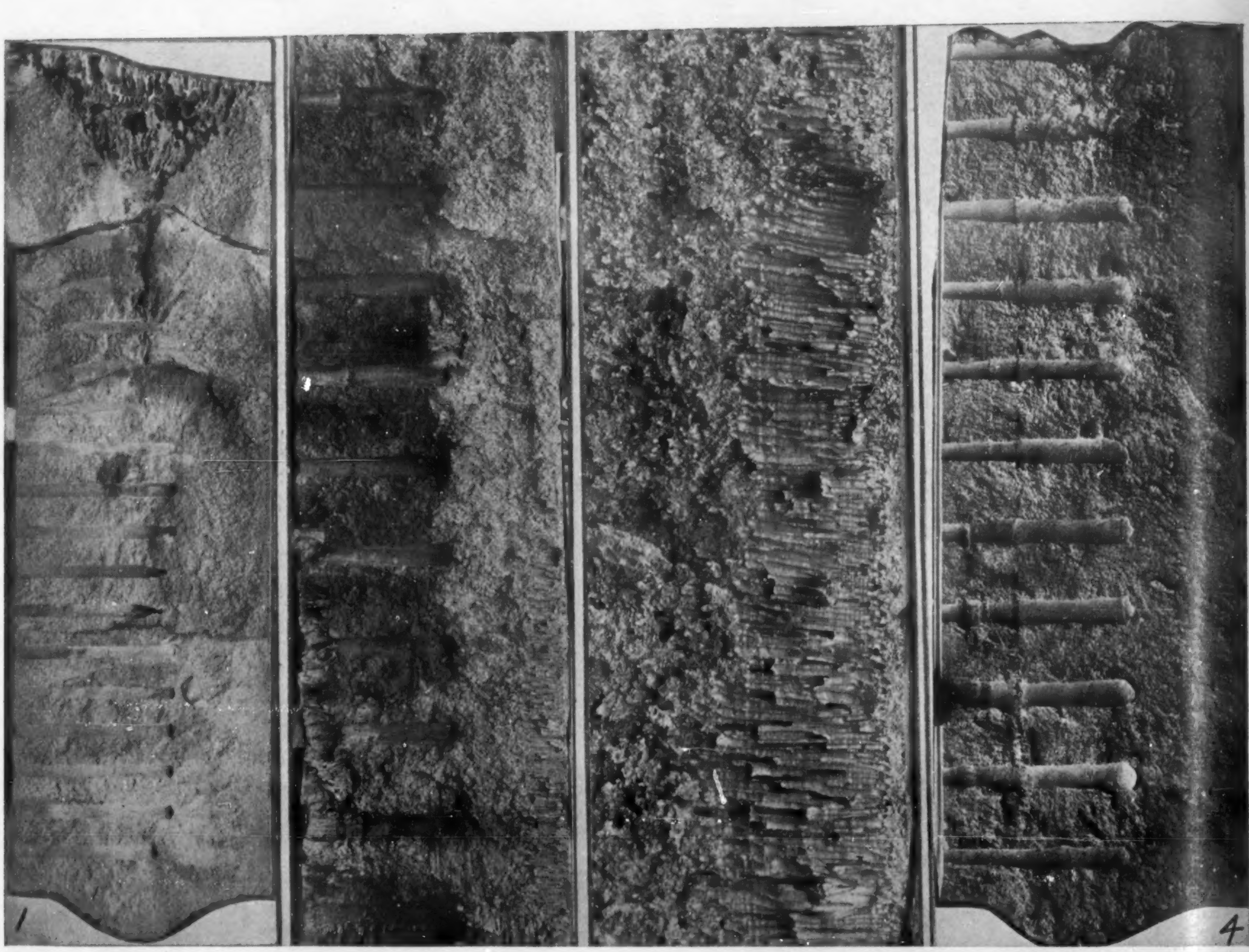


Figure 1. Killed Ingot Split Longitudinally Through the Center.

	C	Mn	P	S	Si
Analysis:	.96	.36	.020	.016	.280

Ingot Size: 27″ x 27″ x 83″

Figure 2: Rimmed Ingot Split Longitudinally Through the Center

	C	Mn	P	S
Analysis:	.11	.39	.011	.026

Ingot Size: 22″ x 24″ x 72″
Thickness of Skin: ¼ inch
Depth of Secondary Blowhole Zone: Top, 4½″; Bottom, 4½″-5¼″

Figure 3. Blowhole Zone of the Ingot Shown in Fig. 2

Figure 4. Rimmed Ingot Split Longitudinally Through the Center

	C	Mn	P	S
Analysis:	.10	.44	.008	.022

Ingot Size: 24″ x 43″ x 58″
Thickness of Skin: Bottom, ¼ inch; Midway, 2 inches
Depth of Secondary Blowhole Zone: Bottom, 3-7″; Midway, 6″

Stick aluminum is also added to the ladle, the amount used depending on the percentage of FeO in a slag test taken before the spiegel addition. It has been found that this aluminum addition tends to compensate for variations in the iron oxide content of the slag and, together with the addition of some aluminum to the molds, helps to control the rimming action.

The action desired in the molds is to have the level of the steel drop slightly (0″ to 1″) after topping off and before starting to rim. This has been found to result in the most satisfactory ingot structure for deep drawing sheet steel.

In order to show the characteristic internal structure of rimmed steel ingots, and the variations that occur in practice, several split ingot sections are shown in the accompanying photographs. It might be of interest to explain the method used in obtaining these ingot sections. A series of holes 1⅜″ in diameter and 6″ apart are drilled along the center line of one side halfway through the ingot. Electric detonators are used, and after the sticks and caps are in place the holes should be firmly tamped with damp clay. The ingots are usually split by one round of dynamite, but occasionally it has been necessary to use two or three rounds.

Fig. 1 is shown in order to compare the structural features of a killed ingot with the rimmed ingots that will follow. This type of ingot has a well defined pipe at the top, but the remainder of the ingot is relatively sound. In some cases blowholes may be found in this grade of steel—these usually being near the surface and confined to the top half, though they also may be present in the lower portion.

Fig. 2 shows the characteristic internal structure of a rimmed ingot of the thin skinned type. It will be noted that there is no well defined pipe similar to that found in the killed ingot shown in Fig. 1. Instead of a pipe, this grade of steel has a porous zone at the top which, as a result of the segregation of carbon, phosphorus, sulphur and to a lesser extent, manganese, is high in these elements.

In the lower half is seen the primary blowhole zone extending along the base and about half-way up the ingot, and the secondary blowhole zone about 5″ from the surface and extending almost the entire length of the ingot. These two zones are a characteristic structural feature of rimmed steel.

Fig. 3 is an enlarged view of a portion of the blowhole zone about a third of the distance from the butt of the ingot shown in Fig. 2. Between the primary blowholes and the surface is a zone of solid metal termed the skin of the ingot which, in this case, is about ¼″ thick. Above the primary blowholes can be seen the line of secondary blowholes.

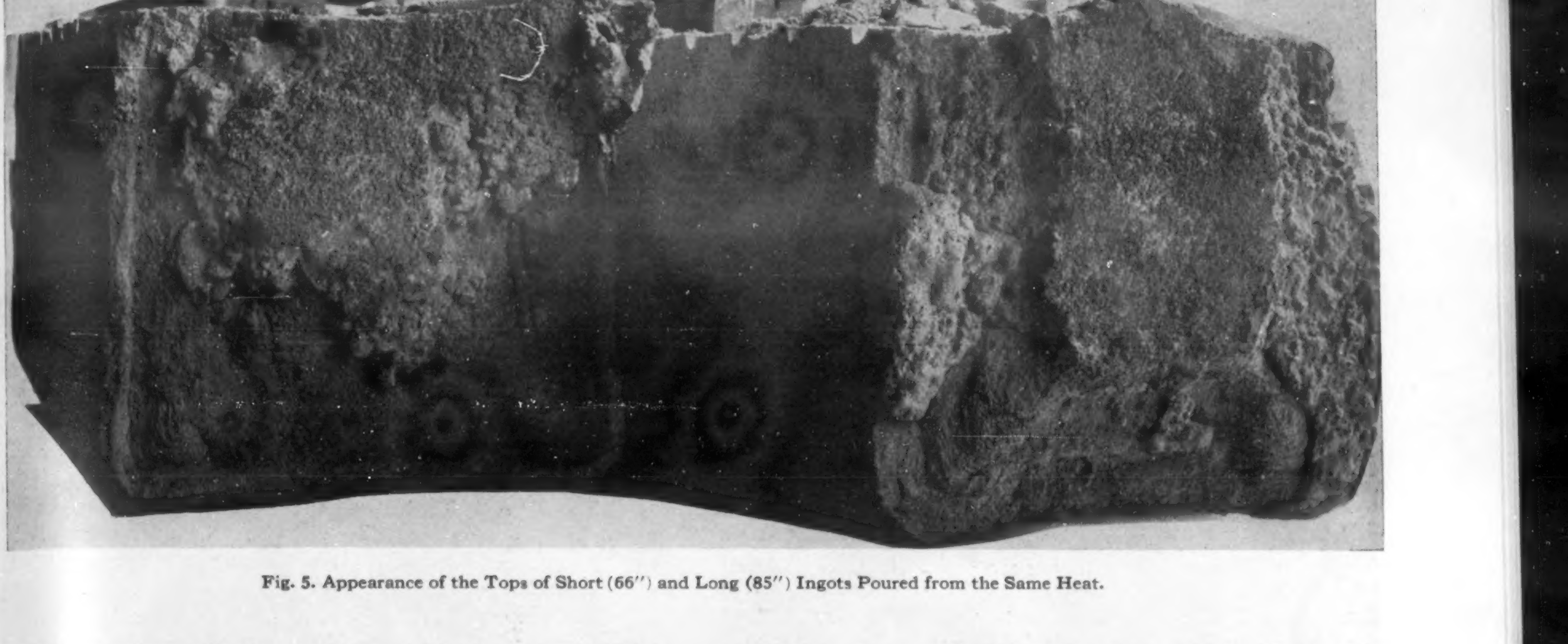


Fig. 5. Appearance of the Tops of Short (66″) and Long (85″) Ingots Poured from the Same Heat.

Fig. 4 shows the type of ingot which is most satisfactory for deep drawing steel. The primary blowholes are almost suppressed, even at the lower end. Although the secondary blowholes are well defined, they are fairly deep seated, being about 6″ from the surface. There is also relatively little concentration of carbon in the upper portion, the maximum being .15% carbon at the top.

Fig. 7 is an enlarged view of the bottom corner of the ingot shown in Fig. 4. It will be noted that the primary blowholes are short and of small diameter.

Fig. 8 is an enlarged view of a section of the side midway between top and bottom of this ingot. The primary blowholes near the surface have disappeared and there is only a small line half-way between the surface and the secondary blowholes.

It has been found that this type of ingot structure is obtained only when the open hearth practice is satisfactory and when the correct size of ingot is used. It has also been found that there is a limit to the height of an ingot of any given cross-section, beyond which it is difficult to obtain a satisfactory internal structure. The ef-

Fig. 6. Comparison of Short and Long Ingots Split Longitudinally Through the Center.

	C	Mn	P	S
Analysis:	.10	.45	.012	.021
Ingot Size	24″	x	43″	

		66″ High	85″ High
Thickness of Skin:	Bottom	⅜″	⅜″
	Midway	1½″	⅝″
Depth of Secondary Blowhole Zone:	Bottom	3 - 6″	3 - 6″
	Midway	5″	4″

fect of ingot height is illustrated in the following figures.

Fig. 5 is a view of the tops of a short and long ingot poured adjacently in the same heat. The short ingot at the left has the type of top that results from a fairly satisfactory rimming action, though it dropped less before and during rimming than is desirable. The ingot at the right rose about an inch before starting to rim, and continued to rise during the formation of the rim.

Fig. 6 shows the internal structure of these two ingots. It will be noted that the primary blowhole zone is much less pronounced in the short ingot and does not extend as far toward the top. The secondary zone is further from the surface in the short ingot, the distance being

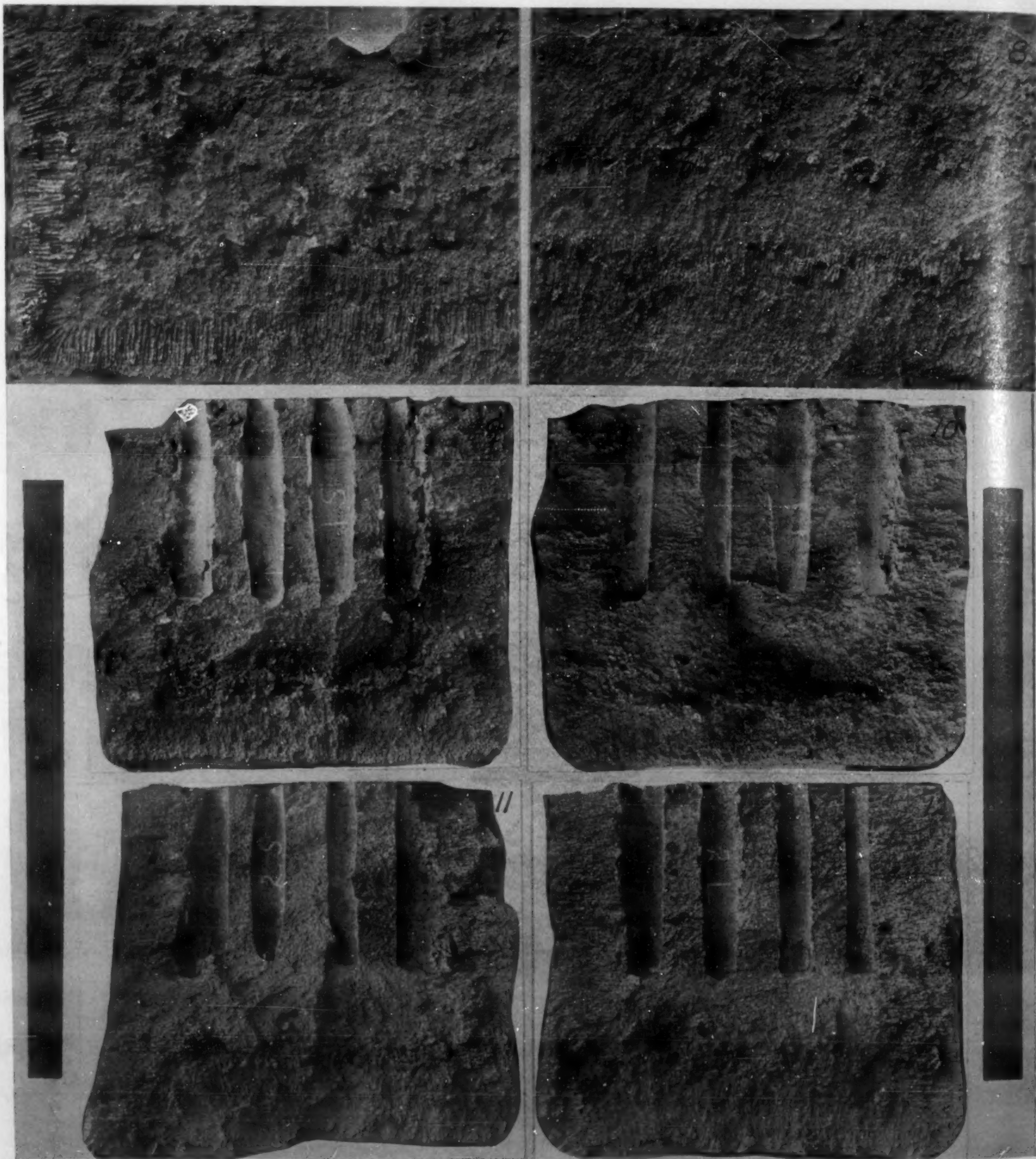


Fig. 7. Detailed Section of the Bottom Corner of the Ingot Shown in Fig. 4.

Fig. 8. Detailed Section of the Side Midway Between the Top and Bottom of the Ingot Shown in Fig. 4.

Fig. 9. Transverse Section 10 Inches from the Butt of the Short (66″) Ingot Shown in Fig. 6.

Fig. 10. Transverse Section 10 Inches from the Butt of the Long (85″) Ingot Shown in Fig. 6.

Fig. 11. Transverse Section 20 Inches from the Butt of the Short (66″) Ingot Shown in Fig. 6.

Fig. 12. Transverse Section 20 Inches from the Butt of the Long (85″) Ingot Shown in Fig. 6.

about 5″ as compared to 4″ for a long ingot.

Fig. 9 shows a section of the short ingot 10″ from the butt, and Fig. 10 shows a similar section of the long ingot. The difference between the two types of ingots is not so apparent at this point as it is higher in the ingot.

Fig. 11 shows a section 20″ from the butt of the short ingot. It will be noted that the ingot is relatively thick skinned at this point, the blowholes being suppressed so that there is a fairly sound skin for a depth of over an inch.

Fig. 12 shows a similar section of the long ingot 20″ from the butt. The blowholes are still well defined and extend to within a quarter inch of the surface.

The ingot zones shown in these photographs are significant from the chemical as well as the structural standpoint. At the secondary blowhole zone, an abrupt change occurs in the composition of the steel. This apparently is the result of the change that takes place in the ingot solidification at the secondary blowhole zone, which marks the point where the ingot is capped and the rimming action ceases.

The zone between the secondary blowholes and the surface is low in carbon as compared to the central zone. This presumably results from selective freezing, the carbon being rejected from the solidifying outer portion to the liquid interior of the ingot. While the ingot is rimming the conditions are favorable for carbon removal from the zone of crystallization either by convection or in the form of gas. This prevents the concentration of carbon along the surface of advancing crystals and favors the solidification of relatively pure metal. When the rimming action stops, this condition no longer exists, and the normal segregation of carbon occurs toward the center and upper portion of the ingot.

The results from the two ingots that have been drilled at representative points in the longitudinal sections show an average carbon content of .040% for the zone between the secondary blowholes and the surface, and .064% for the inner, or core, zone. The average ladle analysis of the steel was .097%. It is apparent, from these results, that an appreciable amount of carbon is lost during the rimming period.

Phosphorus and sulphur were found to be distributed in the same manner as carbon. There was practically no difference in the manganese content of the two zones, but some manganese segregation occurred at the top of the inner zone.

The type of ingot which has been found to be the most satisfactory for the production of deep drawing sheets has the following characteristics:

1. Small primary blowholes, the outer ends of which are 1/4″ or more from the surface at the bottom of the ingot, and become progressively deeper until the blowholes disappear entirely about half-way up the ingot.
2. A deep seated secondary blowhole zone composed of small blowholes.
3. A minimum segregation of carbon, phosphorus, and sulphur in the upper half of the inner zone.

Research on Frits and Enameling at Mellon Institute

Dr. Edward R. Weidlein, director, Mellon Institute of Industrial Research, Pittsburgh, Pa., has announced that the O. Hommel Company, of Pittsburgh, has founded an Industrial Fellowship in the Institute for the purpose of conducting scientific research on problems of enamel technology. In particular, it is expected that this Fellowship will acquire technical information, through its investigations in the laboratory and in plants, supplemented by the experience of specialists in the Hommel and coöperating organizations, including Enamelers' Guild, of Pittsburgh, that will enable it to serve as a clearing-house of dependable facts regarding frits and their industrial use. Research of the Fellowship will be published for the benefit of enamelers; and advice and information on enameling, and assistance in solving plant problems and in making evaluations or other practical tests of frits, will be extended gratis to companies that wish such technical aid. The incumbent of this Fellowship is Jack W. Waggoner.

American Sheet & Tin Appointments

William A. Wein has been appointed Assistant Manager of Sales of the Pittsburgh District Sales Office of the American Sheet & Tin Plate Company. **Charles Schramm** has been appointed Assistant Manager of Sales of the New York District Sales Office.

Wheeling Asst. Manager Tin Plate Sales

Paul W. Lyon, for a number of years associated with the tin plate division of the general sales department of the American Sheet & Tin Plate Company, has accepted the position of Assistant Manager of the tin plate sales division of the Wheeling Steel Corp. He will be located at the general offices at Wheeling.

American Welding Society Nominations

The Nominating Committee of the American Welding Society has proposed the following names: For President, D. S. Jacobus, Advisory Engineer, Babcock & Wilcox Co., New York; for Senior Vice-President, J. J. Crowe, Air Reduction Sales Co., New York; for directors, A. M. Candy, Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa.; J. H. Deppeler, Metal & Thermit Corp., New York; A. E. Gaynor, John A. Roebling's Sons Co., New York; O. E. Hovey, American Bridge Co., New York; L. S. Moisseiff, Consulting Engineer, New York.

E. F. Houghton & Co. Elects Officers for 1934

At the annual meeting of stockholders of E. F. Houghton & Co., Philadelphia, manufacturers of oils and mechanical leather goods, the following officers were elected: President, Louis E. Murphy; First Vice-President and General Manager, Aaron E. Carpenter; Second Vice-President and Director of Sales, George W. Pressell; Secretary, A. E. Carpenter, III; Treasurer, R. H. Patch. The Board of Directors for the coming year will be composed of the above officers and H. B. Fox, Purchasing Agent.

E. G. Brick, for many years connected with the metallurgical department of the Cadillac Motor Car Co., has become associated with the alloy division of the Youngstown Sheet & Tube Co., 4-138 General Motors Building, Detroit, Mich.

Karl Kautz, Ceramic Engineer, Republic Steel Corporation, delivered a paper entitled, "Further Progress Report on the Study of Gases in Enameling Iron," before the Enamel Division of the American Ceramic Society in convention at the Netherland-Plaza Hotel, Cincinnati, Ohio, February 14.

J. S. Adelson, Chief Metallurgist, Steel & Tubes, Inc., Cleveland, Ohio, addressed two meetings of electrical men at the Hotel Statler, St. Louis, Mo., February 6, on the subject, "The Manufacture of Electric Welded Tubing and Pipe."

New Mill at Youngstown Sheet

The Youngstown Sheet & Tube Co. is installing a Steckel mill in conjunction with its universal plate mill in its Indiana Harbor works. The Steckel mill will produce coiled strips for cold rolling into tin plate. In the Steckel type of mill, hot steel is passed back and forth, through rolls, and coiled within furnaces upon opposite sides of the rolls, reducing the thickness of the steel from an inch or more to approximately one-tenth of an inch. The company has practically completed purchase of electrical and other equipment for the mill. Total cost of installation will amount to about $200,000.

Air Reduction Takes Over Wilson Welder

On January 1, 1934, the Air Reduction Company, Inc. exercised its option on the balance of the capital stock of the Wilson Welder and Metals Company of North Bergen, New Jersey. Air Reduction thus becomes the first of the oxyacetylene welding companies to own a 100% interest in an electric welding organization.

Interconversion of Atomic and Weight Percentages

J. S. Marsh*

CERTAIN properties of the functions used by Smith** lead to several useful short-cut methods of interconversion of atomic and weight percentages. Smith's tables of values of log $\frac{1000x}{100-x}$ (where x is the percentage value to be converted) and of log atomic-weight ratios permit rapid interconversion with accuracy to 0.01%; it will be shown how comparable accuracy may be attained for a number of important systems with a minimum of calculation.

Smith used $1000x$ to avoid negative characteristics. Although permissible and useful, this procedure may tend to obscure the nature of the function; hence, it seems best to examine the function log $\frac{x}{100-x}$, where x varies from 0 to 100. It is to be seen that its value is negative for values of x less than 50, is zero when x equals 50, and is positive for values of x greater than 50. If the graph of the function is constructed, it will be observed that, for each pair of values of $x = x$ and $x = 100-x$, the function values are equal but opposite in sign. Further, it will be observed that the function changes rapidly in the vicinity of $x = 0$ and of $x = 100$ and slowly for intermediate values of x.

Now, in the interconversion of atomic and weight percentages, the value of the log atomic-weight ratio is subtracted from log $\frac{x}{100-x}$ if the conversion is from weight to atomic percentage and added if the conversion is from atomic to weight percentage. Graphically, this means a parallel lowering or raising of the log $\frac{x}{100-x}$ curve. This means also, for example, that if the log atomic-weight ratio is of small positive value, the positive values of log $\frac{x}{100-x}$ are diminished, whereas the negative values of log $\frac{x}{100-x}$ become increasingly negative; consequently, the greater is the value of the log atomic-weight ratio the greater is the spread between the corresponding pairs of values of log $\frac{x}{100-x}$ for $x = x$ and $x = 100-x$. The practical significance of the spread will be discussed later.

*Alloys of Iron Research.
***American Institute of Mining & Metallurgical Engineers, Contribution* No. 60, 1933.

For the reason that log $\frac{x}{100-x} = 0$ when $x = 50$, the greatest possible difference between weight percentage and the corresponding atomic percentage exists at $x = 50$. The difference, of course, is zero at $x = 0$ and $x = 100$. This suggests construction of a curve showing difference values as a function of x. If the value of the log atomic-weight ratio is small, a very open scale may be used. Such a curve was constructed for the iron-nickel system from points for values of x in intervals of 5; since the maximum difference (at $x = 50$) is 1.25, a scale permitting reading with 0.01 per cent accuracy was easily possible. This curve is so nearly symmetrical that, had the whole curve been constructed from points of one branch, on the assumption of symmetry, the maximum possible error (over the range of slow change of the function) would be of the order of a mere 0.02%.

To use such a different curve it is only necessary to add or subtract the difference for a given value of x to or from x, depending upon the direction of the conversion. These operations may be performed by inspection, and are accurate to two decimal places.

This eliminates reference to Smith's tables and obviates the bother of interpolation, once the curve is constructed from relatively few points. For example, it is a matter of seconds to determine that 41.18 weight % nickel is equivalent to 39.98 atomic %, or to convert any other value, by means of the original of Fig. 1.

The extent to which the method is useful is indicated by the data of Table I, in which are given the maximum differences between atomic and weight percentages as a function of log atomic-weight ratio. The limiting factors are the size of the coordinate paper to be used and the accuracy desired. In the third column of Table I are given the maximum errors to be expected if the converted value of $100-x$ is computed on the assumption that the difference between atomic and weight percentage is the same as for x. It is to be seen that, for most purposes, it is sufficiently accurate to assume converted $100-x$ to be known if converted x is known. It must be emphasized, however, that no error enters from this source if the whole difference curve is constructed.

The log atomic-weight ratios of many alloy systems lie well below 0.10. It is clear, then, that the rapid and accurate difference-curve method of interconversion is capable of wide usage. The extent of its usefulness may be illustrated by the data of Table II, in which are given the log ratios for some of the important ferrous systems.

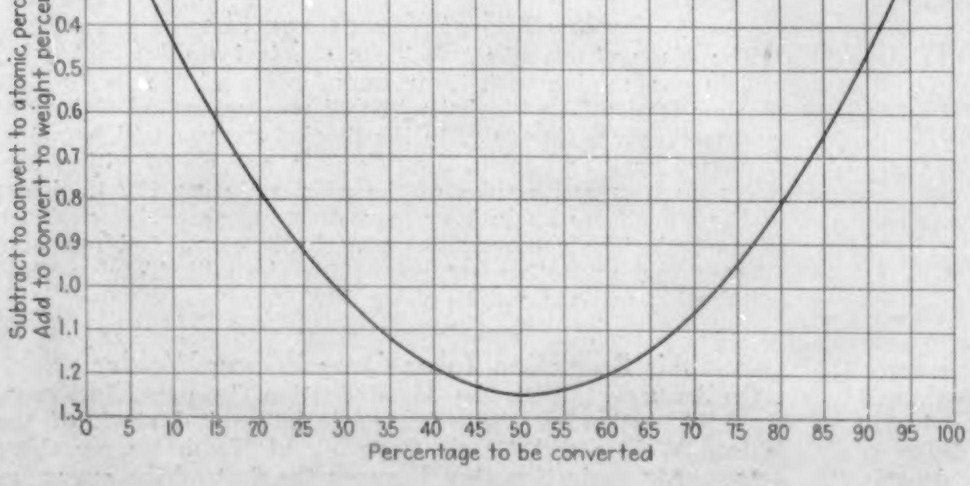


Fig. 1. Difference curve for the Iron-nickel System. (The original curve, on 10x7.5-in. coordinate paper, permits interconversion accurate in the second decimal place.)

Table I. Maximum difference between atomic and weight percentage and maximum deviations (see text) as functions of log atomic-weight ratio.

Log atomic-weight ratio	Maximum difference ($x = 50$) %	Maximum deviation on assumption of symmetry
0.01	0.58	0.00
0.02	1.15	< 0.01
0.03	1.73	0.01
0.04	2.30	0.02
0.05	2.88	0.03
0.075	4.30	0.08
0.10	5.73	0.13

Table II. Log atomic-weight ratios of a few important ferrous systems.

System	log $\frac{\text{atomic weight Fe}}{\text{atomic weight M}}$
Fe-Mn	–0.0071*
Fe-Ni	0.0216
Fe-Co	0.0235
Fe-Cr	–0.0309
Fe-V	–0.0398
Fe-Cu	0.0563

*log a = $\bar{1}.0$ = —(1 — log a)

Some Principles of
INDUSTRIAL RESEARCH

H. A. Schwartz*

No. 2 in a series of Case Histories in Metallurgical Research

IT IS the writer's purpose to point out certain fundamentals which seem to him of importance in rendering scientific principles of use in industry and which, therefore, lie at the root of useful industrial research. Each principle will be illustrated by suitable examples in order to preserve the Case Record treatment of the subject.

1. An industrial research laboratory can not confine itself to any particular form of attack upon its problems but must vary its viewpoint with the circumstances. Thus 30 years ago there was no published or systematic knowledge as to the effect of carbon upon the tensile properties of malleable cast iron. The obvious highbrow method of attack would have been to prepare laboriously a series of alloys differing only in carbon content, cast them into specimens, graphitize under standard conditions and test. In the then state of knowledge such a program would have been not only impracticable of execution due to difficulties of precise control of melting conditions but would have been psychologically impossible, for no one knew that carbon was the element of predominant importance, though the writer suspected it. The actual question as then understood was what makes malleable cast iron differ in physical properties and the simplification, what is the quantitative effect of carbon, could not be formulated until that element's importance was recognized. It would have been just as intelligent to start experimenting with an alloy series varying in some other elements so that perhaps five variables would have had to be investigated separately and in combination on a laboratory scale. However, there were available analyses and tests of some 10,000 heats of malleable cast iron. These already existed as a graphic log in which the composition of each successive heat with respect to the 5 common elements and the tensile strength and elongation were plotted.

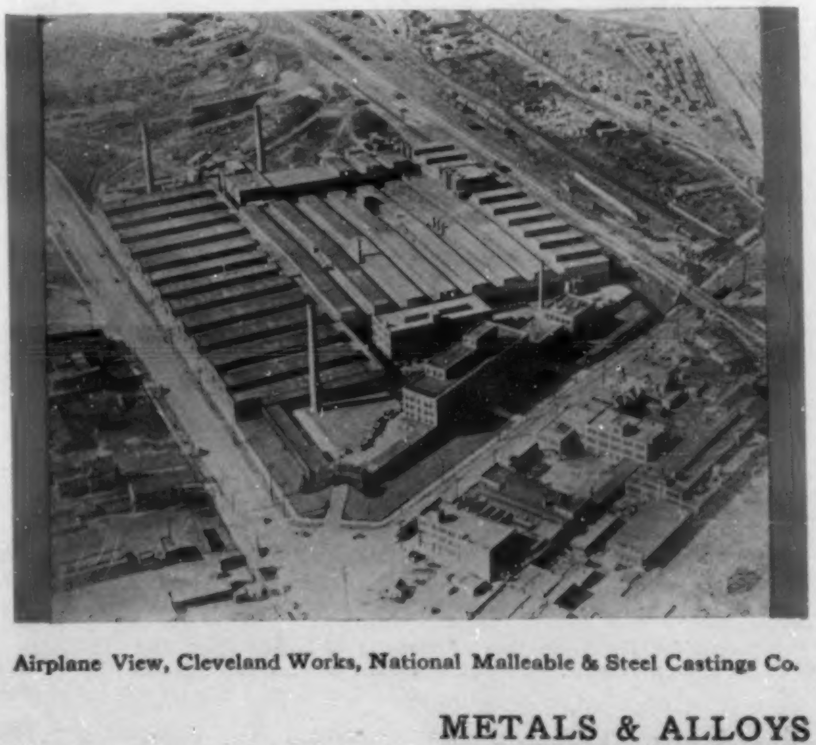
A little patient scrutiny easily disclosed that in general the tensile properties were high when carbon was low and vice versa. The data for about 3,000 of these heats were transcribed on individual cards, which were then sorted into groups constant in composition as to one or more elements and averages taken. The great effect of carbon and lesser effect of other elements (within limits) immediately became apparent and a very fair evaluation of the effect of carbon was obtained all by the efforts of a girl clerk working on routine data.

Some 15 years later it was desired to know the effect of decarburization in anneal on tensile properties. For this purpose a system of investigation under more closely controlled conditions was useful. The total carbon after anneal of all test specimens cast from heats made in running practice but falling within a very small range of composition was determined and compared graphically with the tensile properties and fairly definite conclusions drawn. Here the group was smaller in number, a few hundred, but major causes of variations in properties were excluded by the process of selection. The greater uniformity thereby introduced permits of reliable use of data from a smaller group. Had we proceeded as before not only would there have been an enormous increase in analytical work involved but other variables might have obscured the effects of the one under investigation.

Still 10 years later we were desirous of knowing quantitatively the effect of nickel on graphitizing rate. Here no mass of operating records on commercial material is available and we proceed by the orthodox method of making a series of melts varying only as to nickel and measuring relatively precisely their graphitizing rates. We secure precision in the first case by the use of many observations, each of only moderate precision, in the latter by perfecting the experimental procedure as much as possible and limiting ourselves from practical necessity to a relatively few samples.

The choice between the procedures depends upon the character of the problem and the available data. When investigating a subject in which the fundamental principles have been thoroughly established it is usually well to evaluate the important factors by precise observation on controlled material. When the fundamentals are too poorly understood to permit of subdividing the problem into its rational component parts a study of a great volume of data is indispensable.

2. If it is a duty of the research department to critically study the efficacy of plant methods for an intended purpose, variations from established practice and their effects are best studied by a continuous comparison of the results achieved with those expected. Thus the effect of carbon on tensile strength is rectilinear except for a



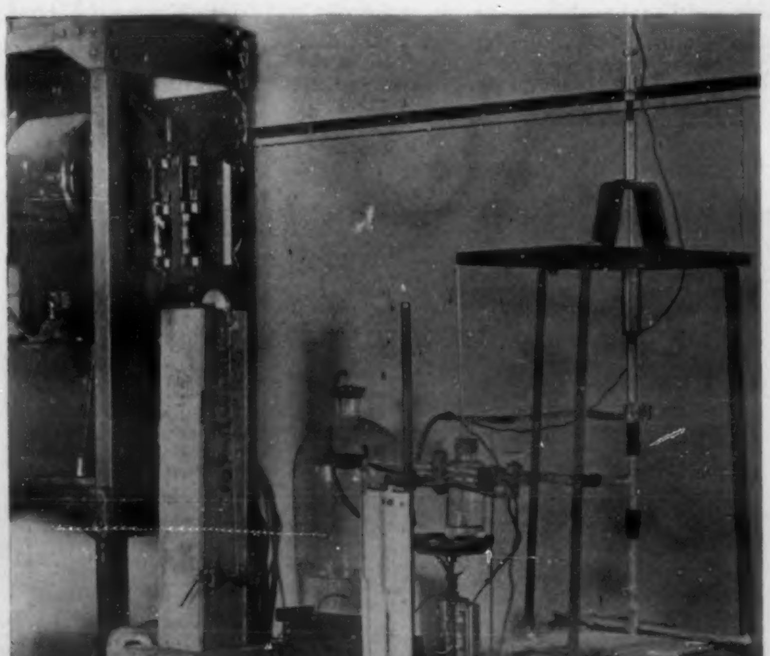
Airplane View, Cleveland Works, National Malleable & Steel Castings Co.

*Manager of Research, National Malleable & Steel Castings Co.

characteristic departure at very low carbon. It was pointed out by others that this departure existed mainly in lower silicon iron. A comparison of the data from about a dozen other foundries with those collected by the writer showed that the departure was not characteristic of any particular limiting value of carbon but existed at the low carbon range of all groups irrespective of the absolute carbon content. It soon became obvious that these groups are those which in any plant have been, through misadventure, abnormally decarburized in the furnace pointing to another previously unsuspected variable in the general problem. Such information can never be had from purely laboratory investigation.

3. Research as to operating methods must to conducted under controlled conditions. It is never possible to run a plant so as to eliminate every variable of operation except that under investigation. The interfering variables must be minimized as far as possible and then the investigation must be so planned as to make it probable that the remaining variables are constant for the two processes being compared. This is analogous to the control guinea pig in biological and medical research. The fallacy of uncontrolled conditions recalls to mind an experience of many years ago. Plant records showed certain foundry losses which might reasonably be minimized by a suitable increase in phosphorus content which was made. The point was not of major consequence and the results were not followed continuously, but a year later the annual summary showed an increase in these losses almost exactly as of the date of change. A change in the reverse direction was at once made and strangely enough, resulted in a second increase in the losses. Evidently the phosphorus increase was sensible but an additional and still unknown variable had undone its good effect.

It would be hopeless to plan an exhaustive research in the hope of discovering this variable. On the other hand, this department was once charged with the responsibility of determining whether charcoal pig iron presented advantages over coke pig iron. The differences might be in physical properties, annealability, foundry losses, melting losses, etc., etc. The first problem might be solved in the laboratory provided a controlled melting method was available; the second also by special laboratory methods available to us; the others are shop conditions having almost no analogue in the laboratory.



Equipment for Determination of Density of Liquid Cast Iron, Research Department, National Malleable & Steel Castings Co.

A program was laid out whereby 2 furnaces in a plant used one charcoal and the other coke pig in alternate weeks. The same jobs and molders were kept on the furnaces and the sand was watched according to the best control the plant could think of. Arrangements were made to anneal the product of both furnaces mixed together in the same pots. Exhaustive records as to compositions of mix and charge and as to foundry losses and annealing rejections by jobs were kept and tests of tensile properties, machinability and graphitizing rate made continuously. Fluidity and shrinkage specimens were poured and the test carried on about 3 months. Under these circumstances sufficiently concordant observations were possible to solve the problem definitely in terms of money. Observations under uncontrolled conditions on a few heats would have been hopelessly misleading.

4. Although a research department is supposed to know all pertinent facts in the literature, no conclusions of importance should ever be drawn from such data without subsequent check as to correctness. It was a universally accepted text book statement that cast irons are low in permeability because of graphite content yet investigation has disclosed that malleable cast iron is the most permeable of the common and cheap ferrous alloys when properly made. It is also true that what is mechanically a good malleable casting is not necessarily of the highest quality magnetically. Investigation of magnetic properties by the customary physical laboratory methods developed at one time a large business in magnetic specialties which would have been lost on the basis of the incomplete text book knowledge.

5. It is wise for a research organization to have very complete knowledge of the possibilities of all the materials made by the parent company. The preceding experience is one instance. Another involves the desire of a large railway interest for a cheap metal having somewhat unusual hardness possibilities. The plant organization to whom the inquiry came struggled unsuccessfully with the problem until they realized that they were about to lose the business. Consultation with the Research Department showed without further experimentation that a standard steel made in another works of the company could be simply heat treated to produce the desired result. This scientifically insignificant piece of knowledge sold a large tonnage and influenced the design of all railway car parts for an important purpose.

6. Some means must exist by a system of filing, and indexing of available data by which desired data will come to attention when required. No such system, in the writer's opinion, can be relied upon to function without help from human memory. The line of investigation which led to a patent on the acceleration of graphitization by first quenching white cast iron from an elevated temperature traces back to the writer's recollection of the appearance of fractures of malleable so produced as an incident to much earlier work in an entirely different connection. When later fractures of malleable in which temper carbon is finely divided, resembled the writer's recollection of these earlier fractures a road was suggested which after additional and rather lengthy experimentation led us into the right fields.

7. Research workers must use extreme care in being sure that their laboratory methods are actually adapted to the desired end. Especially is this true if an accelerated or simplified form of test is involved. Many observ-

ers have accepted, apparently without question, the conclusion that the Amsler rolling friction machine yields results comparable with the resistance to abrasion of commercial wheels. The writer happens to have had opportunities for studying the behavior of steels in the Amsler test and as commercial car wheels on a large scale. It can be said with some degree of assurance that tests made on the machine in the usual manner cause failure by an entirely different mechanism from that which causes wheel wear. Although the machine may give entirely concordant and reproducible results, these results bear no necessary relation to the relative merits of different materials in service. Any attempt to define or select wheel steels on the basis of this test would result in disaster, all of which is not to say that the device may not be a very useful one for many other purposes. The selection of wear resistant materials on the basis of indentation hardness is another similar fallacy. Very hard steel is abraded more rapidly by quite soft materials than by moderately hard ones. In all cases where the service requirements can not be directly stated in terms of very simple characteristics, static stresses, resistivity, density or what not, it is *always* necessary to actually *prove* that the criteria being measured do in fact measure the service condition no matter how obvious the relationship may seem. This appears to be especially true with regard to corrosion problems.

8. The solution of a problem may be entirely successful commercially and scientifically an utter failure. By repeated trials under all kinds of conditions it has been found that the heat treatment perfected by L. H. Marshall while working under the supervision of H. S. Rawdon at the Bureau of Standards, will entirely prevent the embrittlement of ordinary malleable on subsequent galvanizing. (Some malleable is immune to embrittlement and some may be deteriorated by the Marshall process, but these are not "ordinary" malleable.) Neither Marshall nor anyone else has explained why the process works. The engineer is perfectly satisfied, but to the metallurgist no useful knowledge has yet resulted. Unfortunately, problems in this state usually do not get solved for the economic reason for a solution has disappeared.

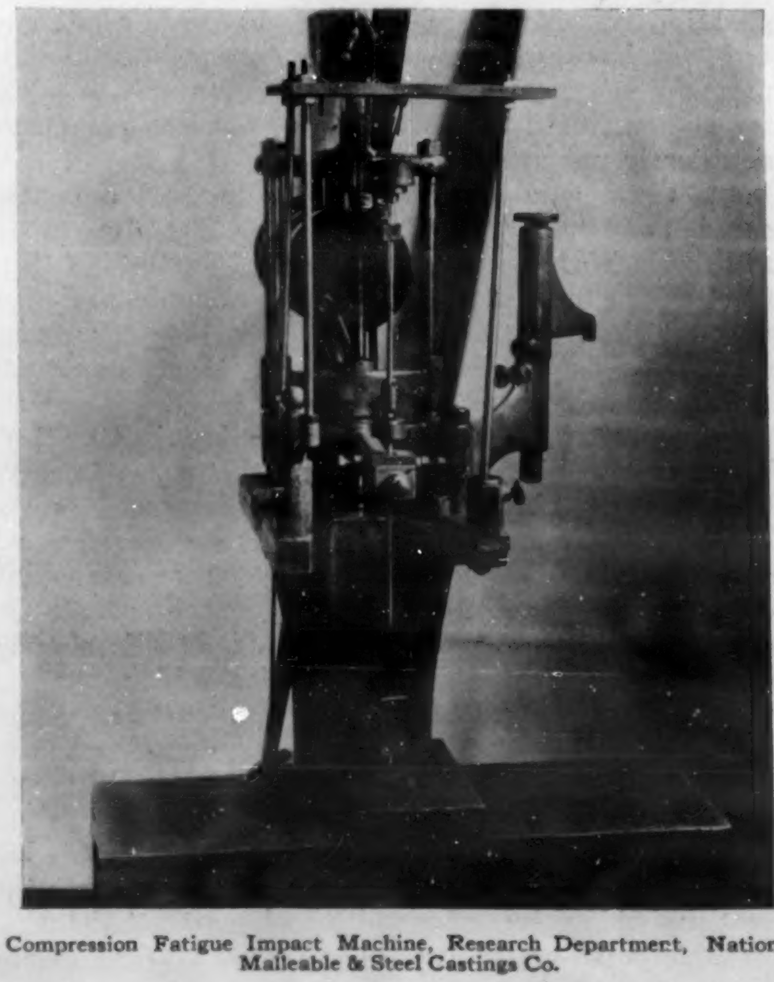
9. Problems may be scientifically successful but of no commercial use. Thus counteracting the adverse effects of sulphur on graphitization of malleable by additions of cerium or lanthanum is both in theory and laboratory practice successful but too costly for commercial use under present conditions. A cast metal of extremely low eddy current loss was developed in this laboratory on strictly logical and scientific reasoning based on original experimental data, but there seems at present no particular market for such a material. The ordinary research organization must be very careful not to divert too much of its effort into probably unprofitable directions.

10. Research which seeks to apply fundamental, established scientific principles to production processes by confirming their applicability determining experimental constants and so on when well done is of the highest and most useful type. The work of Herty and his co-workers in studying the chemical reactions of the steel-making processes, especially the open hearth, is an outstanding example. The study of the Mn-S ratio in malleable cast iron from the viewpoint of the mass law is one more familiar to the writer.

11. It may often be the duty of a research department to investigate the fundamentals of an industrial process with a view to its improvement through a better understanding of the essentials. Thus the writer has been engaged for some 20 years in studying the mechanism of graphitization. Although the purpose of such investigation may be strictly utilitarian, the manipulation and mental attitude may have nothing in common with the commercial art. In the case cited one line of attack was a determination, experimentally, of the progress of graphitization with time. It was found that these observations could not possibly be reconciled with the logarithmic locus characteristic of a first order reaction and therefore that the reaction $Fe_3C = 3\ Fe + C$ was determined as to its velocity by other conditions. The form of the graphite-time curve in the initial stages of graphitization was found to be the same for all alloys and all temperatures (within the original scope of investigation), the characteristic form was defined by mathematical methods and the observed form reconciled with a reaction whose velocity is determined by migratory rates. Out of this grew a useful laboratory method of measuring graphitizing rate and a much better understanding of how the reaction might be accelerated. Later, alloys were found whose graphitizing rate is not consistent with the form corresponding to the postulate that migratory rate determined the reaction velocity and different mechanisms were there recognized.

12. Where it is necessary to rely upon laboratory research as a guide for important plant changes very great precision of laboratory method may be requisite in order to exclude those variables which will exist in the plant but whose effects would average out over an indefinite run. Otherwise such errors may not uniformly affect all the operations of the limited laboratory investigation and vitiate the conclusions.

In a research on the effect of refractories on the annealability of iron the graphitizing rate of metal melted in crucibles lined with mixtures in various proportions of Al_2O_3, SiO_2 and MgO was to be determined. Since it is known that many other melting variables affect this characteristic, great care was requisite lest we misinterpret some incidental effect as important. The melting



Compression Fatigue Impact Machine, Research Department, National Malleable & Steel Castings Co.

stock was for each series of runs a single material of the desired composition made by previous melting together of the requisite materials. These preliminary melts were by several different methods to exclude any peculiarities due to method of preparation, Temperatures were carefully controlled and graphitizing rate determined from observed time-graphite curves. In this way consistent results were obtained permitting of intelligent selection of refractories. It happens that the most desirable refractory from the graphitizing rate viewpoint would be commercially obtainable but has other properties militating against its use. It was, however, possible to select economically permissible standard materials which in commercial use permitted a reduction of at least one-third in the annealing time of electric furnace malleable and patent protection was obtained.

13. This ability to isolate and study the effect of a single cause is in many cases one of the principal reasons for laboratory investigation. "Things are not always what they seem" in metallurgy as well as elsewhere. One must be able to define clearly his problem. It was once observed that certain metal contaminated with tin was difficult to anneal. Before setting out to determine the relation or lack thereof between these coincident facts we must decide whether the question is the effect of tin on the rate of graphitization in the iron-carbon system or the effect of tin in annealing commercial malleable iron. The answers to the 2 questions are not the same.

A considerable laboratory program showed that if tin be added in rather small amount to commercial melts annealability is impaired but that this is due to a reaction between tin and the sulphur compounds of manganese producing manganese and an Sn-S complex which behaves like FeS in retarding annealing. The manganese also somewhat retards the process. If, however, tin be added to more nearly pure melts in which manganese and sulphur are reduced to small amounts or to melts in which sulphur is combined with rare earth bases no detrimental effect occurs. Tin in commercial malleable is harmful but tin does not significantly affect the graphitizing rate of iron carbon alloys. The correct answer is that which applies to the observer's conditions. It is not, however, always easy or even possible to state properly the governing conditions in which case the translation from laboratory to plant conclusions becomes notoriously untrustworthy.

14. Very many observers, especially the less experienced, fall into error or fail to utilize their data to the full for lack of adequate mathematical analysis of their results. To cite as a somewhat simple example a problem with which the writer has had some contact, we may measure the length of a specimen at various temperatures and attempt to express the relation of length to temperature by plotting the observed points and connecting them by lines. It will be at once apparent that a smooth curve would be a more logical locus. We may draw such a curve by eye but find it impossible to have the curve smooth and also pass it through all the points. Two courses are open; we can force it to be smooth and draw it in the course we think "most probably" right. Experience seems to show that unaided by special methods we are not very good guessers of probability except where the plot is nearly straight and the scatter very small. Alternatively, we may recognize that the relation of length to temperature has been found in the most careful work to be of a particular form ($l_t = l_o [1 + \alpha t + \beta t^2]$). We may then, by the method of least squares, calculate the most probable values of α and β and construct the most probable curve of the *particular form* known to be applicable to the problem under investigation. Such a curve is more suitable for accurate interpolation or extrapolation than one put in by eye. The observer can not be accused of having warped his graph in accord with a preconceived notion for each step in the determination of the locus can be checked as to logic and numerical accuracy and lastly, by suitable calculation applied to the departure of individual observations from the curve the worker can form a pretty positive opinion as to how exactly he may rely upon his observations.

On the other hand, if the locus of a series of observations can not by any possibility be reconciled with that which should apply to the problem, having in mind the known precision of observation, the worker is at once warned that something is going on in his experimentation which was not contemplated in advance and which should be investigated. In the problem cited an allotropic change would necessitate a different equation on each side of the transformation temperature.

15. Lastly—an industrial research laboratory has one purpose and one only, namely, to furnish to the parent organization information of value. In order that this end may be achieved it is well that the purpose of each project be clearly envisaged. When the information desired is confined to measurements of the same or many properties of a product or the definition of established operating conditions in terms of compositions, temperature, etc., there is no difficulty in defining the purpose of an investigation and proceeding straight to a specific answer. Whether or not such experimentation constitutes research may be debatable at least.

When the desired information is more general and more fundamental in character as should usually be the case with problems submitted for research, the investigations fall into 2 classifications; specific problems for which a specific solution is desired and which in general involve in a considerable degree the inventive faculty and problems in which it is desired to study somewhat exhaustively the circumstances and conditions of a given material or type of material or a given process.

In the one case success is dependent upon the development and recognition of certain highly specialized information, in the other success is had when all the useful information has been gathered irrespective of whether that information can be applied in any specific concrete manner or not.

Columbus set himself the goal of finding a westward passage to the Indies. In that he failed although he died believing he had succeeded. The fact that he found something much more important, a new continent of greater potential value than Asia, does not alter the fact that he failed in what he sought to do. Nor is this altered by the fact that in view of the Portuguese explorations along the African coast what he sought to do was not worth the effort. Nor did he fail because his problem had no solution. Magellan did what Columbus meant to do. He failed solely because the groundwork for the achievement of his goal had not yet been adequately prepared, in the form of explorations of the American coast line. So it can be with research. Investigations which set themselves a very limited and precisely defined purpose may waste time for they can not succeed unless the necessary preliminary exploration of general character has preceded them. Diffuse investigations having no definable purpose also waste time for such progress as is made may not be in any useful directions.

It seems wise to set up in any research program a few definable but broad purposes and to spend no great amount of time upon any investigation which does not

bear a conceivable relation to some one of these subjects. Subjects which may be only an incident to the general purpose need not and should not be entirely disregarded provided always they are not pursued in directions having no relation to the major purposes. Few touchdowns are scored by running across the field although the ball may be so carried into a favorable position for kicking goal.

A few of the major ends sought in the writer's personal experience have been to reduce annealing time of castings, to reduce foundry losses, to improve any one of many properties of malleable castings, to devise more abradant resistant materials for use in ball mills and to improve the service of steel car wheels.

Consider only the first and last. We would reword the first for research purposes as a determination of the factors determining graphitization rates; the last as a determination of the factors destroying car wheels in service.

Under the first problem we may study the effects of certain elements on graphitizing rates, or the effects of certain operating conditions thereon; examples have already been cited.

To study graphitizing rates intelligently we must have a method for its evaluation. This involves a study of the mechanism of graphitization. Having learned something of the mechanism and the methods of measurement and evaluation, which involves also a study of sampling losses of graphite in chemical analysis and the question of whether finely divided graphite is oxidizable by HNO_3 we will wish to reconcile the observed effects of elements with theory by determining in what manner they affect the mechanism. We find that number of graphite nucleii are considered of importance and are led to a mathematical study of the relation between the numerical distribution of the diameters of temper carbon clusters as seen under the microscope and the distribution of diameters of the spherical masses whose sections the observed spots are. As a basis for the mechanism of graphitization we obviously must consider the stable and metastable iron-carbon diagrams and their modifications in ternary and more complex systems and to understand these modifications at all we must concern ourselves with the chemical thermodynamics of solutions. It is possible that these principles can be better studied in non-ferrous alloys and we must give thought to at least surveying that field. Some of these problems, if isolated, seem abstruse and of no practical relation to the parent industry. They are unless we clearly envisage them as means to an end.

In the car wheel problem we are concerned first with investigations as to the stresses and other possible causes of failure in car wheels. We consider the evaluation of their magnitudes from wheel loads, velocities of cars, brake action, etc., etc. We must consider, adopt or devise means for measuring those properties which determine or are supposed to determine wheel life. We must consider changes in properties of steel incident to use by work hardening, temperature, etc., and study the effects of composition and heat treatment upon the properties which seem of importance in determining wheel service. Bearing in mind that under complex conditions it is difficult to subdivide a problem for purpose of study we must fall back on field study of wheels in service and evaluate operating data obtained under many conditions of place, time and material, our own and others, in such a manner as to decide what is desirable and what undesirable. Here we are led into the field of statistical mathematics in order to decide within what limits the deductions from a given group of data may be relied upon. Again, although our interests scatter into many fields, they all have a definitely traceable relation to a definite commercial problem.

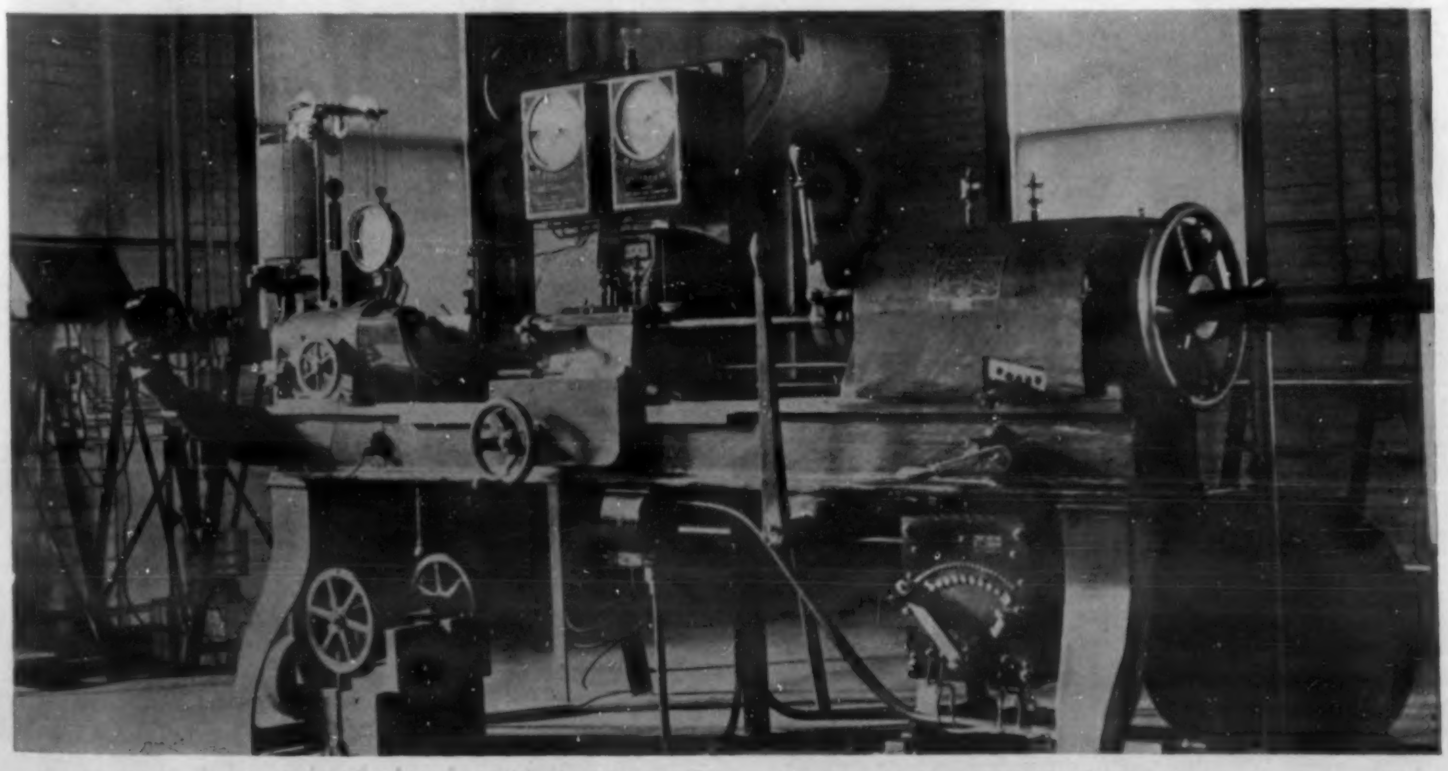
There seems no general rule or plan but it seems to the writer that the interests of the smaller organizations would be best served by adopting the following general principles:

a. Spend no money in investigating subjects not demonstrately connected definitely to some major interest.

b. Spend little money in investigations of the invention type in fields in which the exploratory work is not fairly well advanced either by the organization in question or in the literature.

c. Survey at least briefly any subject having a fairly close relation to major projects paying particular and close attention to the literature in order to minimize experimentation.

d. Study continuously and as exhaustively as possible all subjects closely allied to major projects especially those where an advance in the art seems close at hand in the light of the existing accumulation of knowledge.



Universal Efficiency Machine, Research Laboratory, National Malleable & Steel Castings Co.

Deterioration of Chromium-Tungsten Steels in Ammonia Gases*

Peter R. Kosting**

Introduction

EARLIER SEARCH for material of construction for equipment in which to carry out the synthesis of ammonia revealed that steel with more than 2% chromium satisfactorily resisted the corrosive attack of a gas mixture of nitrogen, hydrogen and ammonia at 500° C. and at pressures of 100 atmospheres.[1,2] A tungsten bearing steel[2] was found to be exceptionally resistant. This paper gives the results of a further investigation in which a series of chromium tungsten steels were exposed for one year to a 3:1 mixture of hydrogen and nitrogen with 10% ammonia at a temperature of 300° C., and at a pressure of 600 atmospheres.

Experimental

Forged steels whose chemical analyses are given in Table I and are graphically represented in the Fe-W-Cr ternary diagram of Fig. 1 were supplied for test by the Midvale Company. A high nickel steel was also included.

Two forms of test specimens were used: tensile test bars, 5 inches in length and with a reduced section 0.361" in diameter; and hollow cylinders as shown in Fig. 2. Two bombs were made by attaching flanges to the test cylinders and clamping 9 of them together. Within these cylinders were placed the tensile test specimens. Both bombs were placed side by side in an electric furnace maintained at 300° ± 10° C.

A 3:1 hydrogen-nitrogen gas mixture containing less than 1% oxygen was compressed over water to 600 atmospheres pressure +80, —100 atmospheres, by the method described by Dilley and Edwards[3] and then passed through liquid ammonia kept in steel bubblers maintained at 65.0° C. whereby approximately 10% ammonia was picked up in the vapor phase. These bubblers were installed early in the test after fire destroyed the original set up where a 3:1 gas mixture was passed through catalysts and ammonia actually synthesized. The gas, after passing through the 2 test bombs which were connected in series, was expanded and allowed to escape at the rate of about 100 cc./min. Fig. 3 shows the actual assembly of the test bombs and Fig. 4 is a diagrammatic sketch of the assembled equipment.

The tensile properties were determined by the Bureau of Standards, Washington, D. C., using a 50,000 lb. capacity Amsler Testing Machine. The yield point was taken as the point of "drop of beam" as recorded on the stress-strain diagram. The hardness was determined as Rockwell "B" numbers on flat surfaces ground on the unreduced areas of the tensile test specimens.

*Fertilizer and Fixed Nitrogen Investigations, Washington, D. C.

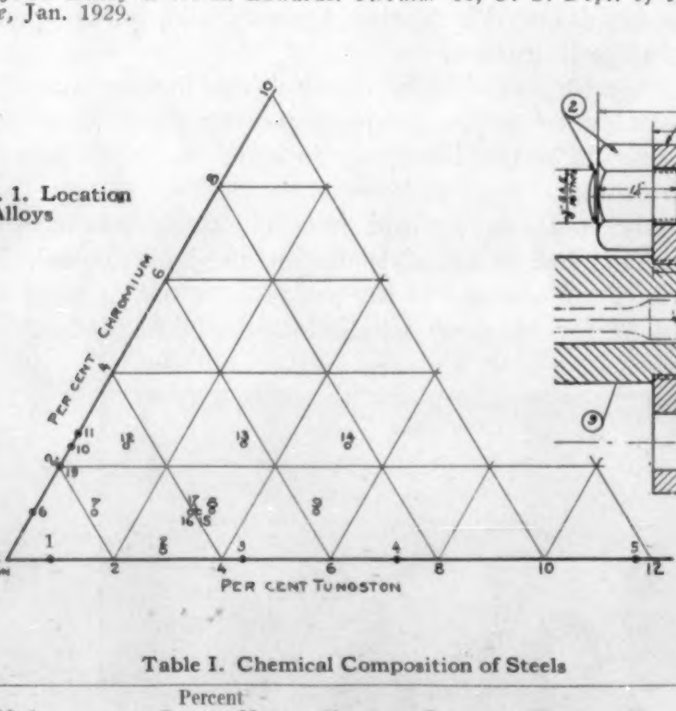
**Watertown Arsenal, Watertown, Mass.

[1] J. S. Vanick. *Transactions American Society Steel Treating,* Vol. 4, 1923, page 62. *Proceedings American Society Testing Materials,* Vol. 24, II, 1924, page 348.

[2] J. S. Vanick, W. W. deSveshnikoff & J. G. Thompson. *Bureau of Standards, Technical Paper,* 361, 1927.

[3] J. R. Dilley & W. L. Edwards. *Circular 61, U. S. Dept. of Agriculture,* Jan. 1929.

Fig. 1. Location of Alloys



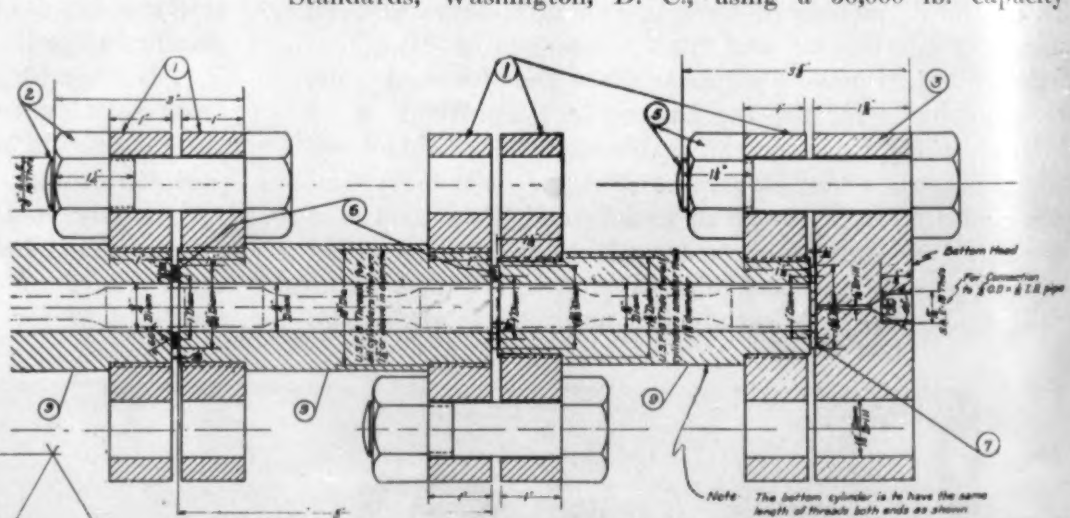


Fig. 2. Detail of Test Cylinder. (1) Flanges. (2), (5) Nuts and Bolts. (3) End Piece. (6), (7) Copper Gasket. (9) Test Cylinder.

Table I. Chemical Composition of Steels

Mark	C	Mn	Si	Cr	W	V	Ni
	Percent						
1—382	.36	.50	.24	—	.81	—	—
2—386	.33	.41	.19	.20	2.85	—	—
3—387	.38	.46	.14	—	4.40	—	—
4—388	.32	.49	.16	—	7.25	—	—
5—417	.35	.50	.08	—	11.69	—	—
6—CRV–6	.3–.4	—	—	1.00	—	.07	—
7—390	.34	.44	.21	1.00	1.15	—	—
8—391	.37	.50	.26	1.06	3.30	—	—
9—392	.33	.33	.23	1.04	5.25	—	—
10—399	.33	.43	.28	2.42	—	.20	—
11—460	.40	.56	.23	2.67	—	—	—
12—393	.32	.46	.24	2.44	1.05	—	—
13—394	.33	.47	.19	2.49	3.20	—	—
14—396	.34	.43	.14	2.45	5.15	—	—
15—395	.12	.44	.12	1.01	3.10	—	—
16—397	.57	.47	.15	1.04	2.93	—	—
17—433	.93	.60	.22	1.12	2.94	—	—
18—459	.29	.65	.24	2.20	—	—	29.35
*19	.3–.4	—	—	1.9–2.1	—	.18–.20	—

*Replacement for bomb 17

Fig. 3. The Test Bombs

After exposure, the hollow cylinders were longitudinally split and the corroded surfaces were plated with copper and were coated with Wood's metal. Specimens for microscopic examination were then cut out and polished, the exposed edges being protected by the plate. However, it was with exceeding difficulty that proper etching was carried out.

Results

The tensile properties and hardness of the steels before and after exposure are diagrammatically shown in Fig. 5. Fig. 6 shows the tensile test specimens after exposure. All were pitted except alloy 18 which was only discolored. For the double purpose of showing an original crack in the alloy and of showing an unexposed specimen for comparison, specimen 18a was shown in the illustration.

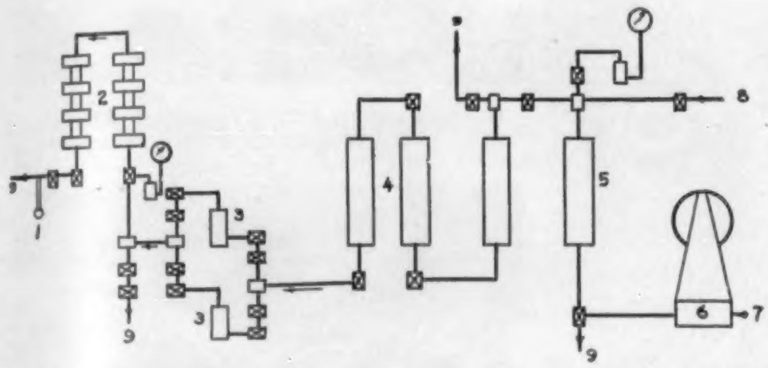


Fig. 4. Assembly of Apparatus. (1) Gas Flow Meter. (2) Test Bombs in Furnace. (3) Ammonia Bubblers in Thermostat. (4) High Pressure Gas Storage. (5) Compression Chamber. (6) Hydraulic Pump. (7) Water Inlet. (8) Low Pressure Gas Inlet. (9) Outlets for Sampling or Blowoff.

The microphotographs shown in Figs. 7 to 11 are representative of the results of the metallographic examination. Only alloy 1 showed serious detrimental effects. Most of the more complex steels showed dendritic structures. There was no evidence of decarburization. Slag within the metal was unaffected. Occasional voids found at the very surface were believed to have been originally filled with slag which was actually exposed to the gases at an adjacent point.

Early in the test, the cylinder made of alloy 17 failed mechanically. It was replaced by one made of alloy 19.

The high nickel steel showed a decided reduction in properties though the metallographic specimen showed but slight evidence of intergranular attack.

Discussion

Since Figs. 8 and 9 revealed that the process of deterioration was one of intergranular corrosion, those physical properties indicative of ductility should be affected the most, and this was found to be particularly true for alloy 1 with an 82% reduction in elongation.

For purposes of comparison, the individual changes in properties of the alloys are listed in Table 2, the alloys being collected into groups as therein indicated.

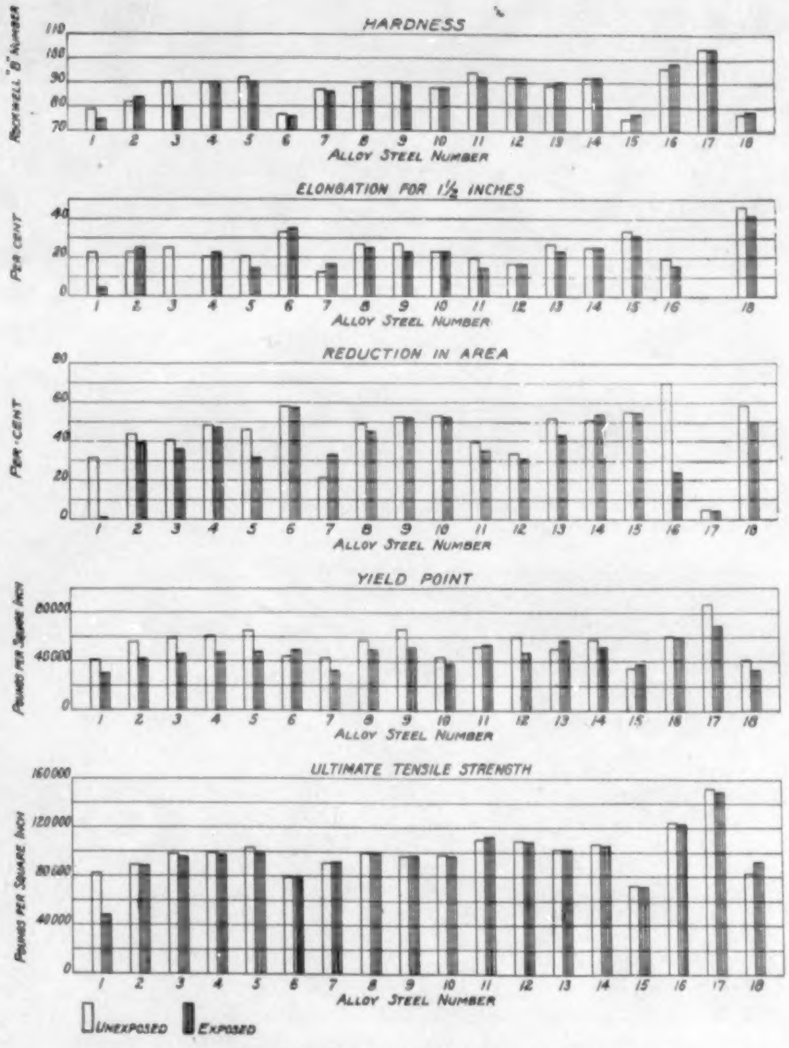


Fig. 5. Tensile Properties and Hardness of Alloy Steels.

The alloy that suffered the most change was No. 1 with 0.81%W. Increasing the tungsten content materially improved the resistance to deterioration. However, there was no benefit from adding more than 2.85%W; as much as 11.69% was detrimental.

Chromium was a more effective addition element, 1% being sufficient to impart resistance to deterioration. No improvement was made by adding tungsten to chromium steels, but the addition of chromium to tungsten steels was very beneficial and there were indications that the more the tungsten the more the chromium required.

The upper limit for the carbon content was found to be 0.35%. Lowering the carbon content may give better resistance but with a sacrifice in the strength of the alloy.

The external appearance of the tensile test specimens was no

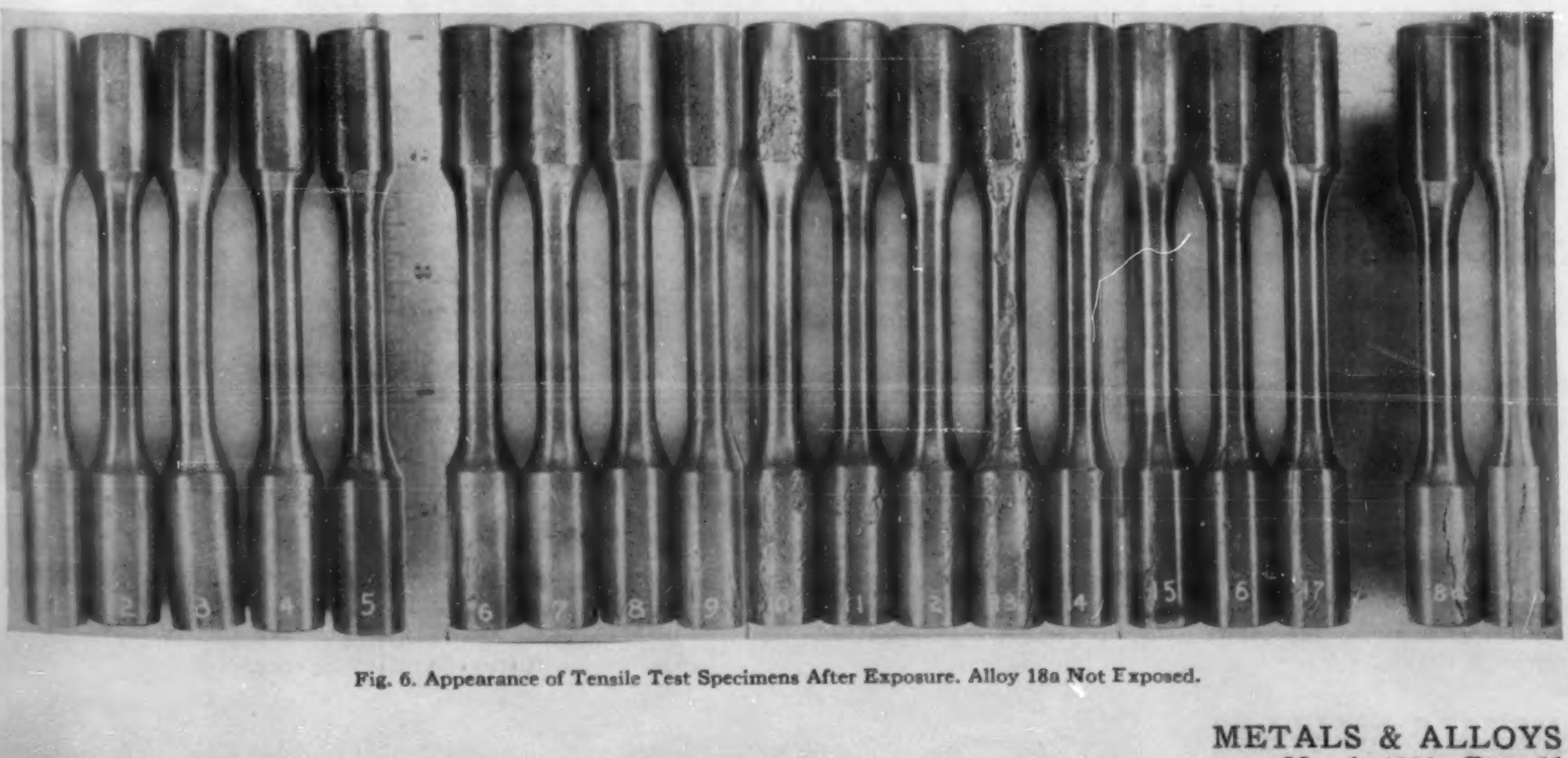


Fig. 6. Appearance of Tensile Test Specimens After Exposure. Alloy 18a Not Exposed.

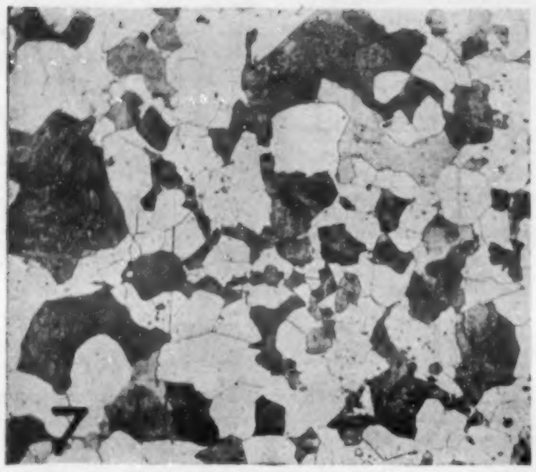


Fig. 7. Alloy 1 (0.81%W : 0.36%C). Unexposed. Etched, Magnification 100×.

Fig 8. Alloy 1 (0.81%W : 0.36%C). Unetched, Magnification 500×. After Being Exposed to Ammonia-Hydrogen-Nitrogen Gas at 300°C. and 600 Atmospheres Pressure. Intergranular Corrosion is Evident.

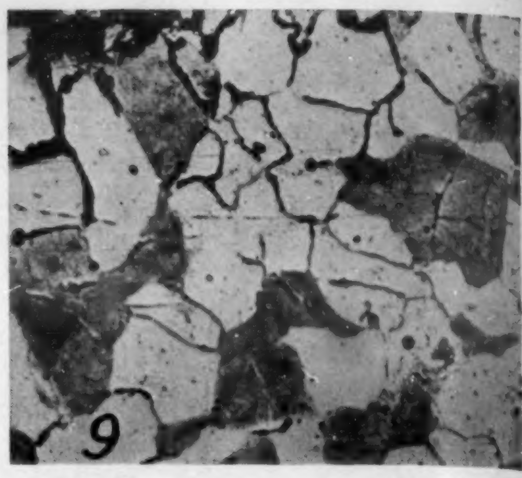


Fig. 9. Alloy 1 (0.81%W : 0.36%C). After Exposure. Etched, Magnification 200×. Same as Fig. 8.

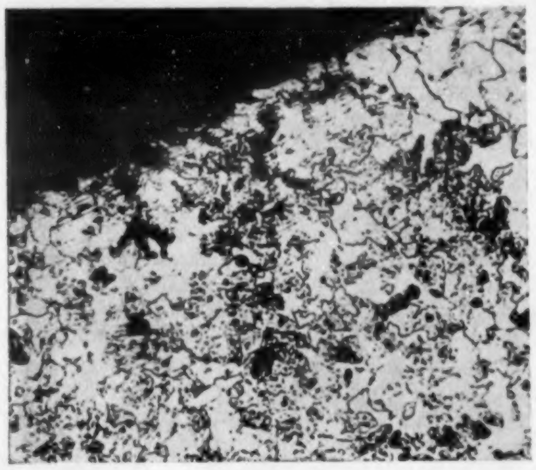


Fig. 10. Alloy 6 (1.0%Cr : 0.35%C). After Exposure. Etched, Magnification 200×. Same Exposure as Fig. 8.

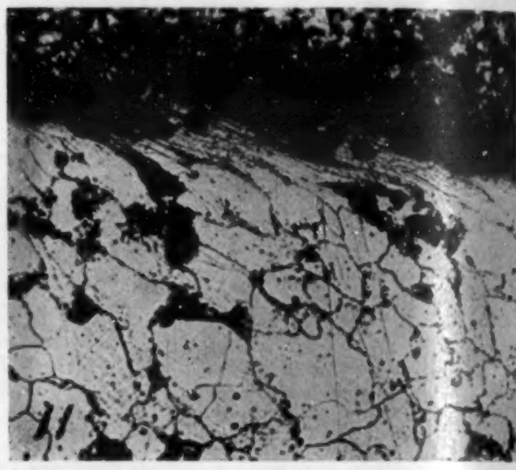


Fig. 11. Alloy 15 (1.01%Cr : 3.10%W : 0.12%C). After Exposure. Etched, Magnification 200×. Same Exposure as Fig. 8.

Table 2. Change in Tensile Properties

Constant Element / Increasing Element	Group No.	Tensile Strength lbs./in.^{2}	Δ %	Yield Point lbs./in.^{2}	Δ %	Reduction in Area %	Δ %	Elongation %	Δ %
0%Cr W	1	—34,600	—42	—10,800	—26	—30.8	—98	—18.8	—82
	2	— 600	— 0.7	—13,700	—25	— 4.2	—10	+ 2.1	+ 9
	3	— 1,900	— 2	—13,300	—23	— 4.8	—12	—	—
	4	— 1,800	— 2	—13,200	—22	— 1.1	— 2	+ 2.5	+12
	5	— 4,500	— 4	—17,500	—27	—14.3	—31	— 5.9	—29
1%Cr W	6	0	0	+ 4,900	+11	— 0.4	— 0.7	+ 2.1	+ 6
	7	+ 1,000	+ 1	—10,300	—25	+11.8	+55	+ 4.1	+32
	8	0	0	— 7,800	—14	— 3.7	— 8	— 2.1	— 8
	9	+ 500	+ 0.5	—15,600	—23	— 0.7	— 1	— 6.7	—25
2¼%Cr W	10	— 1,100	— 1	— 4,900	—11	— 0.9	— 2	0	0
	11	+ 1,600	+ 1	+ 900	+ 2	— 4.3	—11	— 4.5	—24
	12	— 500	— 0.5	—12,600	—21	— 2.3	— 7	0	0
	13	— 300	— 0.3	+ 6,400	+13	— 8.6	—17	— 4.2	—16
	14	— 900	— 0.9	— 6,800	—12	+ 2.7	+ 5	0	0
1%Cr. 3%W C	15	— 1,200	— 2	+ 3,900	+11	— 0.4	— 0.7	— 2.0	— 6
	8	0	0	— 7,800	—14	— 3.7	— 8	— 2.1	— 8
	16	— 1,000	— 0.8	— 1,000	— 2	—46.0	—66	— 3.6	—19
	17	— 3,300	— 2	—17,600	—20	— 0.5	—10	—	—
	18	+10,000	+ 1	— 7,800	—19	— 7.9	—14	— 4.2	— 9
0%W Cr	6	0	0	+ 4,900	+11	— 0.4	— 0.7	+ 2.1	+ 6
	10	— 1,100	— 1	— 4,900	—11	— 0.9	— 2	0	0
	11	+ 1,600	+ 1	+ 900	+ 2	— 4.3	—11	— 4.5	—24
1%W Cr	1	—34,600	—42	—10,800	—26	—30.8	—98	—18.8	—82
	7	+ 1,000	+ 1	—10,300	—25	+11.8	+55	+ 4.1	+32
	12	— 500	— 0.5	—12,600	—21	— 2.3	— 7	0	0
3%W Cr	2	— 600	— 0.7	—13,700	—25	— 4.2	—10	+ 2.1	+ 9
	8	0	0	— 7,800	—14	— 3.7	— 8	— 2.1	— 8
	13	— 300	— 0.3	+ 6,400	+13	— 8.6	—17	— 4.2	—16
5%W Cr	3	— 1,900	— 2	—13,300	—23	— 4.8	—12	—	—
	9	+ 500	— 0.5	—15,600	—23	— 0.7	— 1	— 6.7	—25
	14	— 900	— 0.9	— 6,800	—12	+ 2.7	+ 5	0	0

guide to predicting corrosion resistance. Judging from the character of the pits, it was slag that was attacked. But within the metal, slag was unaffected, even in alloy 1. Voids found immediately beneath the surface exposed to the gases are believed to have been originally filled with slag which actually reached the surface at a point adjacent to the plane polished for metallographic examination. The destructive gases could then react with the slag. At the temperature of test no gas diffused through the metal except along grain boundaries.

Comparison with the previous work of Vanick[1,2] would indicate that as the temperature used in synthesizing ammonia is lowered, the less complex the alloy need be to resist corrosion. This fact is already known to the industry. But it is evident that clean steels should be used if only because of the susceptibility of slag to decomposition.

Acknowledgment

The program for this investigation was originally laid out by Mr. J. S. Vanick. Thanks are due the Midvale Company for supplying the steels. The contributions of Dr. J. G. Thompson are acknowledged.

Mr. Tierney carried out much of the routine control work. During the long period in which this work was carried out, many were the changes in personnel at the Fertilizer and Fixed Nitrogen Investigations, who had direct or indirect interest in the work. It was my privilege to complete the last seven months' exposure and to obtain and to assemble the data. To my predecessors, known and unknown, grateful acknowledgment is made.

Conclusion

A steel with 0.81% W was corroded when exposed to a mixture of hydrogen and nitrogen in the proportions 3:1, with 10% ammonia at a temperature of 300° C. and at a pressure of 600 atmospheres, but a steel with 2.85% W was not. The addition of more tungsten was not beneficial, as much as 11.69% was detrimental. The addition of 1% Cr rendered steel resistant, and the addition of chromium to tungsten bearing steels was very beneficial. The carbon content should not be more than about 0.35%. Slag present at any exposed surface was attacked and decomposed, and resulted in pitting.

Cooley Electric Furnace Moves

Cooley Electric Furnace Company, manufacturers of "Bluehead" electric furnaces, is moving its general office and plant from Long Island City, New York, to Indianapolis, Ind., effective March 1, 1934.

Dr. L. C. Pan, Technical Director of the U. S. Research Corporation, and instructor of electroplating in the City College of New York, has been elected a fellow of the American Association for Advancement of Science.

RATE OF

Age-hardening of Duralumin

as Determined by Upsetting Tests

by J. O. Lyst*

IT is a well known fact that duralumin, one of the strong aluminum alloys, does not attain its full heat-treated properties immediately after quenching but ages gradually at ordinary temperatures. Various cold forming operations which are too difficult to be accomplished in the fully aged condition are often performed immediately after quenching while the material is still relatively soft. The rate of age-hardening is of practical importance because it determines the time available for such cold forming operations. In driving small duralumin rivets, for example, it is necessary to do the driving within an hour or two after quenching if the quenched rivets are stored at room temperature. In the aircraft industry it has become common practice to store quenched duralumin rivets at low temperatures in order to prolong the period during which they can be driven, thereby making it unnecessary to heat treat the rivets at such frequent intervals.[1]

In previous investigations of the rate of age-hardening of duralumin the tensile strength, yield strength and hardness have been used as criteria.[2] Recently an upsetting test has been devised at the Aluminum Research Laboratories as a means of studying the workability of various aluminum alloys in upsetting operations and it was thought that this test would serve as a very good criterion of age-hardening especially with reference to the hardening of duralumin rivets. The test consists of upsetting a small cylindrical specimen with a length equal to twice its diameter and measuring the work done in upsetting and the percent deformation at the appearance of the first crack.

The specimens are compressed in a 40,000-lb. capacity Amsler hydraulic testing machine using the apparatus shown in Fig. 1. The shortening of the specimen is read directly by means of a dial gage calibrated in thousandths of inches. Load readings are recorded when the specimen has been shortened 25 and 50% of its original length and the amount of deformation at the first crack is recorded. The average of the 2 load readings divided by the original cross-sectional area of the specimen gives a value which, divided by 10,000 for convenience, is called the workability factor. This factor is an index of the work done in compressing the specimen and is practically independent of the size of the specimen provided the length is twice the diameter. It should be appreciated that this workability factor is not intended to be a measure of the ability of a material to withstand all forms of cold working such as bending, drawing, pressing and spinning. It is simply an arbitrary value used in studying upsetting characteristics. A material having a small workability factor can be upset with less work than one having a large workability factor.

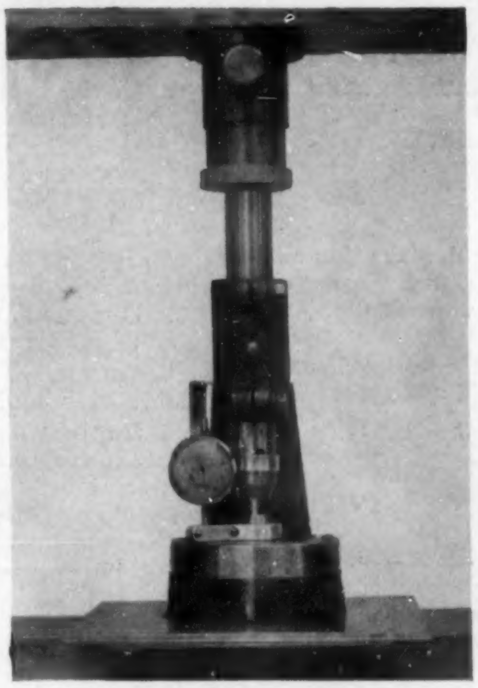


Fig. 1.

Fig. 2.

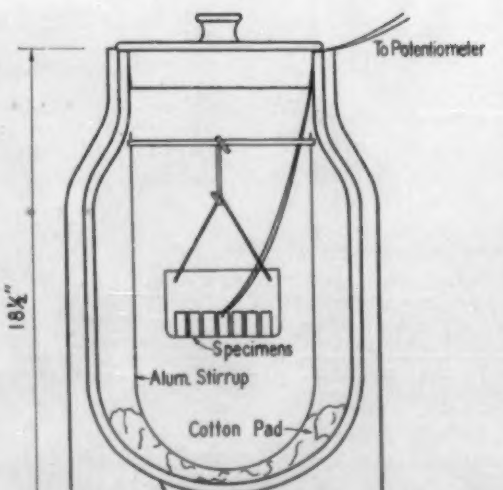


Fig. 3.

Most upsetting operations cannot be carried beyond the point at which cracks begin to form and, therefore, the ability to withstand cracking is important. The upsetting test used in this investigation has the advantage of giving a quantitative measure of the degree of cracking. Previous work with this upsetting test has shown that materials which crack at deformations in the neighborhood of 55% in the upsetting test are very likely to develop head cracks in driven button-head rivets.

The specimens for these tests were cut from $\frac{3}{8}$-in. diameter duralumin rivet stock. One hundred cylindrical specimens were prepared, each having a length equal to twice the diameter of the rod. Only the ends of the specimens were machined, care being taken to make them parallel and normal to the axis of the rod. Fig. 2 shows typical workability specimens before and after testing.

All specimens were heat-treated and quenched at the same time. Forty-three were allowed to age at room temperature (25°C.). Twenty-five were stored away immediately after quenching in an electric refrigerator at a temperature of approximately 0°C. The remaining 32 specimens were placed in a 3-gallon vacuum bottle in Dry Ice (solid CO_2) immediately after quenching. These specimens were maintained at a temperature which ranged between —40° and —50°C. averaging about —48°C. for the period of testing. Fig. 3 shows a sketch of the arrangement for suspending the specimens in the vacuum bottle.

The specimens were tested at various intervals of time over a period of 2 weeks and complete results are plotted in Figs. 4 to 7, inclusive. In Fig. 4 are shown the workability factors and deformations at first crack for the specimens stored at room temperature (25°C.) after quenching. These specimens did not begin to harden appreciably, that is, did not show a distinct increase in workability factor, until about 1¾ hours after quenching. From this point the workability factor gradually increases until at about 6½ hours the workability factor is about one-half way between that of the as-quenched material (10.7) and that previously determined for fully aged material (14.0). No workability factors were obtained on this group of specimens beyond 6½ hours for the reason that the material began to show cracks before 50% deformation, making it impossible to obtain satisfactory load readings.

---

*Aluminum Research Laboratories, New Kensington, Pa.

[1]E. P. Dean. Keeping Duralumin Rivets Workable with Dry Ice. *Metals & Alloys*, Vol. 2, 1931, page 165.

[2]Experiments on Retarding the Age-Hardening of Duralumin. E. H. Dix, Jr. & F. Keller. Transactions, Institute of Metals Division, A.I.M.E., 1931.

"A Study of the Effect of Storage Temperature on the Age-Hardening of Duralumin," Thomas B. Rhines & John Lawrence (Thesis M.I.T., May, 1932).

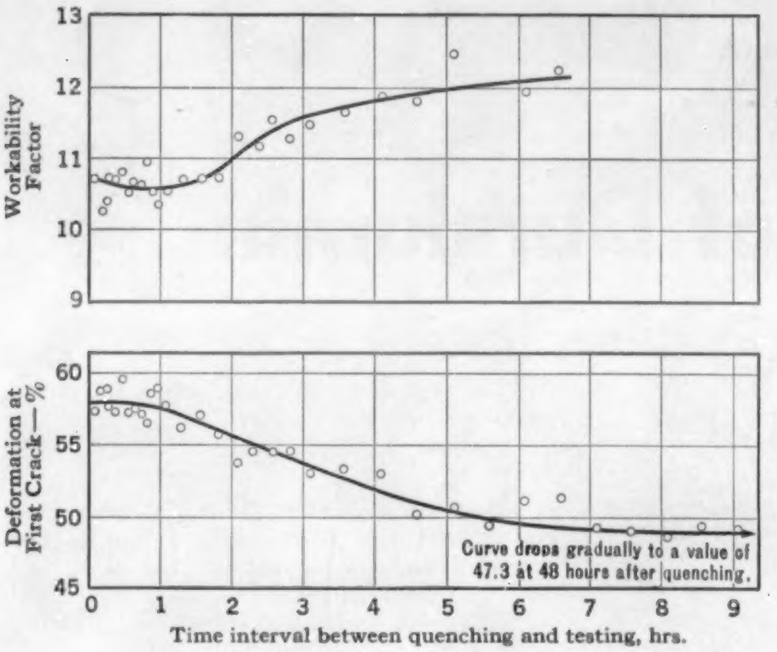


Fig. 4. Tests on specimens stored at room temperature.

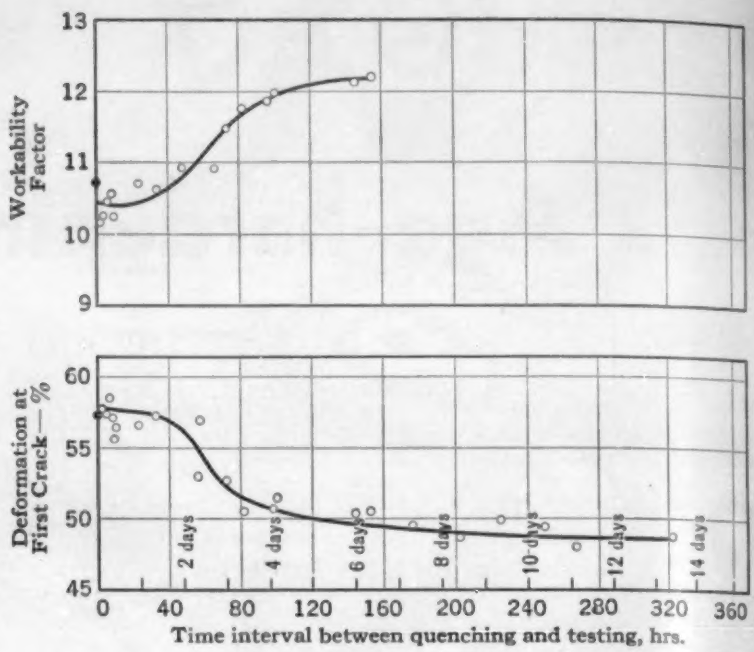


Fig. 5. Tests on specimens stored at 0°C.

The curve in Fig. 4 indicates that the percent deformation at first crack begins to decrease appreciably at about the same time the workability factor begins to increase appreciably. At the end of about 4½ hours the percent deformation at first crack is about one-half way between that of the as-quenched material (57.3%) and the fully aged duralumin (47.3%).

The test results on the specimens stored at 0°C. and plotted in Fig. 5 do not show any appreciable tendency for the specimens to harden until 1½ days after quenching. At the end of 6 days they were at about the same stage of aging as attained by the room temperature specimens in about 6 hours. In other words, it may be stated with fair accuracy that the rate of age-hardening of duralumin stored at 0°C. after quenching is about 1/24 of that of the specimens stored at room temperature, one day in ice water being roughly equivalent to about one hour at room temperature.

The specimens which were stored at —48°C. and tested immediately after removal from the storage container showed no appreciable tendency to harden even after 14 days (Fig. 6). It is not known how much longer the age-hardening could be successfully retarded at this temperature but since 14 days would cover any practical requirement it was considered unnecessary to carry the investigation any further. It may safely be said that storage at —48°C. retards the age-hardening of duralumin at least 200 times as much as storage at room temperature and at least 9 times as much as storage at 0°C.

The workability factors and deformations at first crack for the specimens which were stored at —48°C. for 14 days and then aged at room temperature are shown in Fig. 7. They follow about the same history as those allowed to age at room temperature immediately after quenching.

From the results of these tests the following conclusions can be drawn:

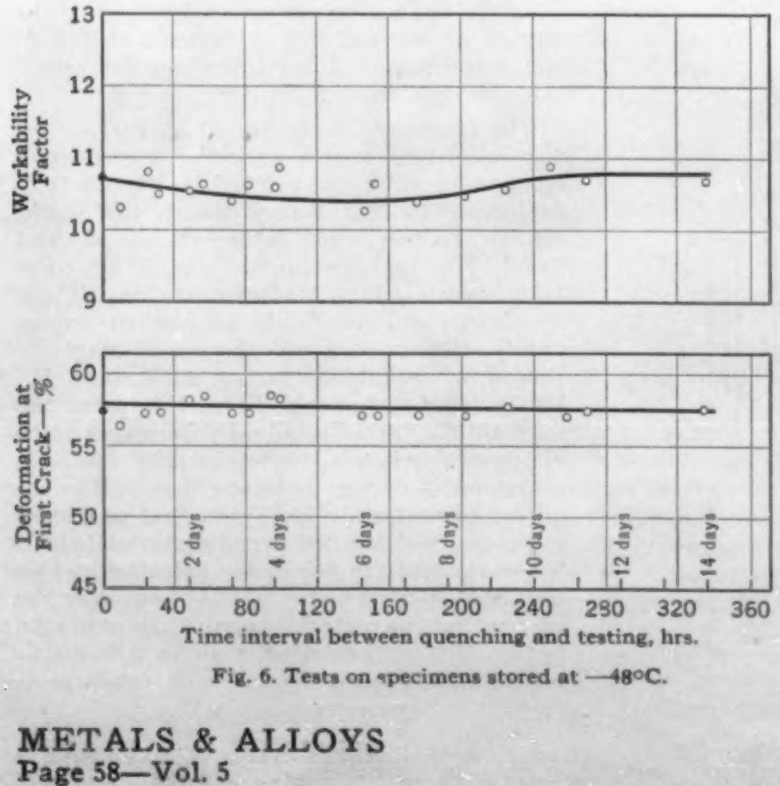
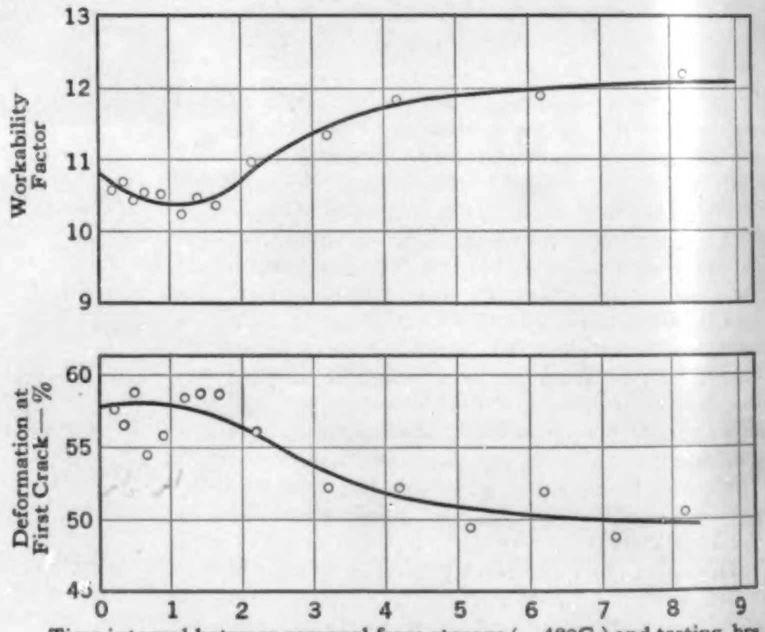


Fig. 6. Tests on specimens stored at —48°C.

1. Duralumin aged at room temperature after quenching begins to age-harden appreciably 1¾ hours after quenching.
2. Duralumin stored at 0°C. immediately after quenching begins to age-harden appreciably about 36 hours after quenching.
3. Duralumin stored at —48°C. does not age-harden appreciably over a period of 14 days.
4. Duralumin stored for 14 days at —48°C. and then removed and allowed to age at room temperature shows approximately the same behavior as duralumin stored at room temperature immediately after quenching.



Time interval between removal from storage (—48°C.) and testing, hrs.
Fig. 7. Tests on specimens stored for 14 days at —48°C. then aged at room temperature.

Acknowledgments:

This investigation was carried out in the Aluminum Research Laboratories of the Aluminum Company of America under the direction of Mr. R. L. Templin, Chief Engineer of Tests. The author wishes to thank him and the other members of the Research Staff who assisted in this investigation.

Special Libraries Association

The Special Libraries Association announces the formation of a "Chemical Division" within their Science and Technology group. The aim of this newly formed division is: to bring in closer contact those librarians, whose work deals mainly with chemistry and allied subjects; to facilitate inter-library loans; to exchange duplicate material; etc. A constructive program will be worked out with the cooperation of all chemical librarians in the United States and Canada. A monthly bulletin will bring to the members a symposium on methods, shortcuts in library practice and many valuable suggestions. Anybody interested in this project is asked to get in touch with Mrs. Jolan M. Fertig, Librarian, Westinghouse Research Laboratories, East Pittsburgh, Pa.

MOUNTING of Small Metallographic SPECIMENS and Metal Powders IN BAKELITE

by H. M. Schleicher* and J. L. Everhart*

IN mounting small specimens for metallographic examination, the usual practice is to use low-melting alloys to obtain a surface of sufficient area for ease in polishing. Although this method has the advantage of speed in the preparation of mounts, difficulties are encountered frequently in attempting to etch the specimens. As Bakelite is not attacked by the usual etching reagents, it is an ideal mounting medium. It has the additional advantage of being hard and does not tend to smear over the face of the specimen during preparation. Recently, pressure molding of Bakelite mounts has been advocated. While this method is useful for hard metals, it is open to question whether it is suitable for very soft materials which may be damaged by distortion. In addition, a molding press is required for the operation. A method for mounting in Bakelite, which has been very useful in the preparation of small specimens of copper and lead and requires only simple equipment, is described below. In this method, bakelite resinoid is used as the mounting medium and the mounts are prepared by heating.

Drying Oven

The temperature necessary for the hardening of the resinoid ranges from 85° to 130° C. These temperatures are readily obtained from the heat radiated by an ordinary electric light bulb placed in a suitably insulated oven.

Fig. 1 is a sketch of an oven which has given very satisfactory results. All necessary dimensions are included. The walls and cover are made of 85% magnesia pipe covering, placed in a galvanized iron shell. A 2" square opening is cut in the wall as indicated in the sketch to permit circulation of air. A metal plate is used to support the cups and this plate, in turn, rests on four ½" diameter by ½" rods, thus allowing circulation of air from the lamp chamber, around the cups, and out of the top of the furnace. A 100 watt, 240 volt lamp is used as the heating element. This lamp is connected in series with an external bank of 3 lamps in parallel. The lamps were selected by trial to obtain temperatures in the range 85°-90° C. and 120°-125° C. For the lower range a 100 watt, 240 volt lamp and a 10 watt, 240 volt lamp are placed in the circuit, for the higher temperature range a 100 watt, 110 volt lamp is used alone in series with the heating lamp. The circuit is connected to the 220 volt mains. To use this dryer on a 110 volt circuit, the 240 volt lamps may be replaced by 110 volt lamps and the 100 watt, 110 volt lamp may be replaced by a 200 watt, 110 volt lamp. Fig. 2 is a view of the dryer as set up.

*Metallurgist, Oxygen-Free Copper Dep't and Metallographer, respectively of the U. S. Metals Refining Co.

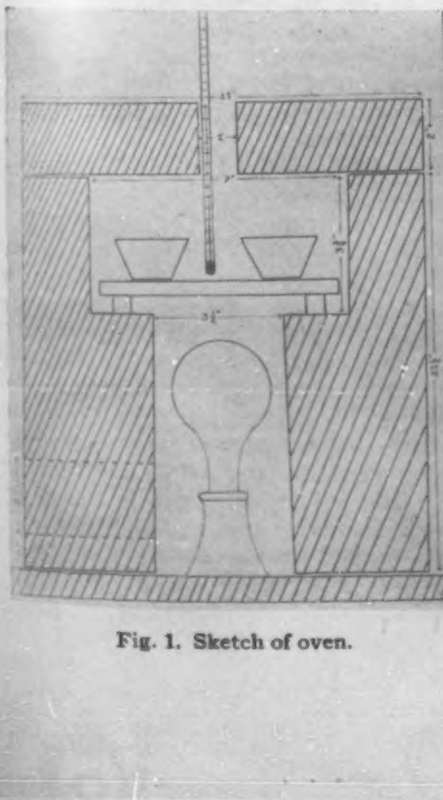


Fig. 1. Sketch of oven.

Fig. 2. Drying oven.

Fig. 3. Typical mounts and wire sample as prepared for mounting.

Preparation of Mounts

In mounting specimens, Bakelite resinoid BR-0014 is used. This is a viscous liquid which may be poured readily. Small porcelain or metal cups which may be from ¾" to 1¼" in diameter serve as molds. For most of the work in this laboratory, the low conical parting crucibles listed by the Denver Fire Clay Company are used. Wires or other slender specimens are set up on wooden or wire forms to hold them in place while the bakelite is hardening. A typical form and a number of mounts are shown in Fig. 3. The cups are greased with vaseline or a similar light grease to facilitate removal of the mounts and about ½" to ¾" of resinoid is poured into them. The forms are centrally located, usually with the surface to be examined on the bottom of the mold, and the cups are placed in the dryer. The temperature is maintained in the low range overnight and then raised to the high range for a period of from 1½ to 2 hours. The cups are removed from the dryer, cooled, and the solidified meniscus is chipped off with a knife blade, after which the cup is inverted, tapped gently, and the completed mount drops out readily. The form is removed and the protruding wires are clipped off flush with the surface of the mount, and the mount may be finished for polishing either by sawing a thin slice from the bottom with a jeweler's saw or by grinding until a plane surface is obtained. The usual polishing methods may be used and no difficulty is experienced with the etching reagents.

In the preparation of metal powder specimens, a small glazed porcelain cup is greased and sufficient powder is poured in to cover the bottom. The powder is covered with bakelite resinoid and the two are intimately mixed by stirring. Then additional resinoid is added to the depth of about ½" and the operation is continued as described previously. The specimen is finished by the ordinary polishing methods and may be examined in the polished condition or etched to reveal the structure. Fig. 4 shows a sample of copper powder prepared by this method. It has been etched with chromic acid. Magnification 100X.

Experience has demonstrated that the Bakelite resinoid cannot be used successfully unless it is fairly fresh. After standing a few weeks, its hardening characteristics undergo some change and it will be found difficult to obtain hard mounts in the manner described. It is desirable, therefore, to purchase the resinoid in minimum quantities and replenish each month. If the resinoid be heated immediately at a temperature higher than the low range specified, the vapor will not escape completely and the mounts will be more or less porous. At a high temperature the resinoid will froth.

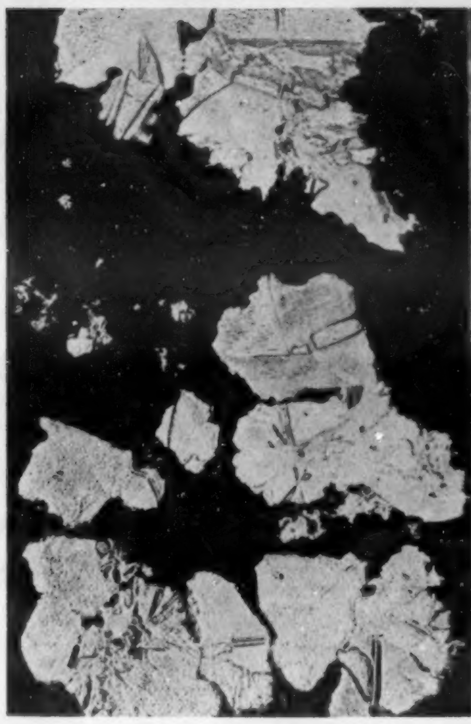


Fig. 4. Cu powder, 100x, chromic acid etch.

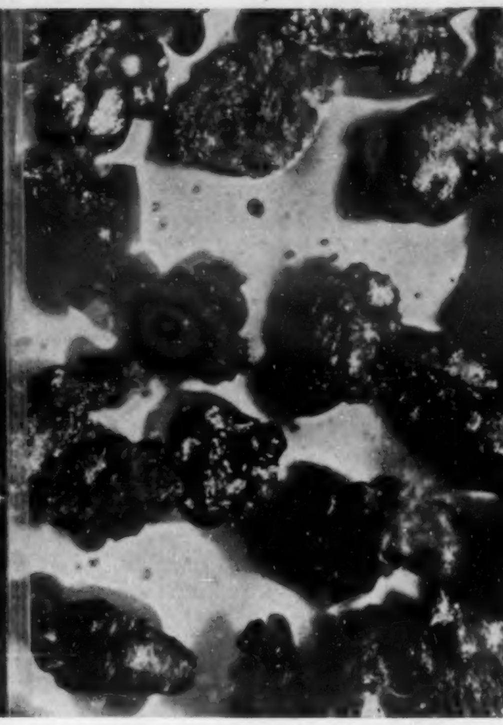


Fig. 5. Copper powder, 150 mesh, 100x.

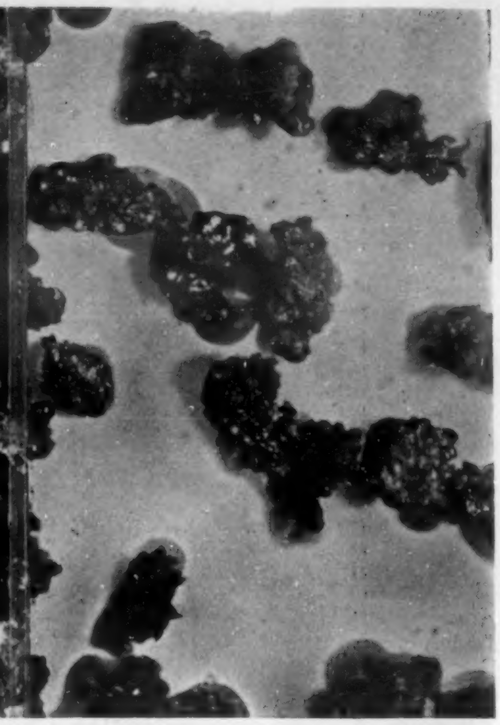


Fig. 6. Copper powder, 200 mesh, 100x.

An ideal arrangement would be a clock attachment to throw a switch early in the morning so that the mounts would be finished when the working day begins.

A method of using the inverted metallurgical microscope to examine metal powders for particle size and other external features, but not for structure, which combines simplicity with rapid preparation of the sample is to mount the material in Bakelite varnish. A thin layer of the varnish is spread on a cover glass and the powder is shaken on the glass so that the particles are sufficiently separated to be discrete but are near enough together to obtain a sufficient number in the field of the microscope for a representative sample. This may be accomplished by pouring some of the sample on a sheet of paper, inclining the paper, and tapping it lightly. After the powder has been shaken on the glass, the excess is removed by blowing gently. The varnish dries rapidly and the specimen is ready, almost immediately, for examination and photography. Figs. 5 and 6 show the appearance of copper powder at 100X magnification as prepared by this method. The form and size of the individual particles can be seen, clearly, although all particles are not completely in focus. No. 5 is 150 mesh powder, No. 6, 200 mesh. The difference is plainly evident and the method may be used for comparing particle sizes.

Acknowledgment

We are indebted to Mr. W. H. Collins, Company Photographer, for the photography.

Editorial Comment

(Continued from page A 19)

made use of the expedient of interleaving a few fairly heavy copper plates at intervals through the pack. These drained the heat more rapidly from the edges to the center and allowed a much greater rate of heat input without overheating the edges. While the copper had to be heated up, the heat input required for this was balanced by the smaller radiation losses from the furnace through the shorter heating period, so that the total requirements for energy in an electric, or fuel in a fuel-fired, furnace would be the same per ton of steel annealed. The advantage lies in greatly speeding up the rate of heating, thus materially increasing the output of the furnace.

This "heat-drain" scheme seems applicable to many metallurgical processes. Carburizing and malleableizing, car annealing of steel castings, and other such operations where it is desirable to convey heat rapidly to the center of a charge of poor thermal conductivity might be decidedly accelerated by adding plates or bars of copper, perhaps chromium-plated for the higher temperatures, if the atmosphere is oxidizing, or oxygen-free, if it is reducing. For temperatures above or too close to the melting point of copper, pure nickel might have to be resorted to. While the conductivity of nickel is low compared to that of copper, it is enough higher than that of ordinary steels, and especially than that of the 18:8 type, to afford interesting possibilities.

Misapprehensions that merely lead to incorrect phraseology are not helpful, but those that lead to the neglect of means for improvement of processes and equipment are definitely harmful. A better understanding of the possibilities and limitations in the use of materials of high thermal conductivity would open up useful applications, on the one hand, and avoid waste from their use where that property really gives them no advantage, on the other.—H. W. Gillett

Reader's Comment

Editor, Metals & Alloys:

I have read the very interesting article in the January 1934 issue of "Metals & Alloys" by Mr. F. B. Dahle, on "Impact Resistance of Cast Iron at Elevated Temperatures."

One interesting result of the findings of Mr. Dahle was not brought out, and we feel that the explanation fits in with the results shown.

It is well known that Molybdenum alloyed in ferrous products increases their high temperature physical properties. This includes not only a considerable increase in creep strength, but an accompanying increase in hardness.

As Mr. Dahle's results show (see Table II) the Molybdenum cast iron has a definitely higher impact strength at room temperatures despite the fact that the Brinell hardness is 36 points higher than the unalloyed iron. The Molybdenum cast irons retain their hardness at elevated temperatures more than do the plain irons.

Acknowledging the fact that a higher Brinell is usually accompanied by lower impact strength, a comparison of Brinells at the several high temperatures might very well explain the narrowing of the superiority of the Moly iron over the plain iron at increasing temperatures. The comparison would probably show a larger spread between the Brinell figures, finally being so great that the Moly iron will, as is shown in the chart (Fig. 3), only have an impact strength equal to the plain iron.

Jan. 26, 1934
Climax Molybdenum Company
New York, N. Y.

C. M. Loeb, Jr.
Metallurgical Engineer

PROPERTIES OF METALS (1)

Magnetic Permeability of Iron Wires in the Wave Range of 46 to 1000 m. (Die magnetische Permeabilität von Eisendrähten im Wellenlängenbereich von 46 bis 1000 m.) K. Kreielsheimer. *Annalen der Physik*, Series 5, Vol. 17, June 1933, pages 293-333. A Wheatstone bridge in connection with an audion tube was used for determining the permeability from its value with direct current to high-frequency. The results can be considered as qualitative only and show that the permeability decreases with increasing frequency. The very exhaustive measurements are compiled in tables and curves. 19 references. Ha (1)

Note on the Paper "Geo-Chemistry of Rhenium" by I. and W. Noddack. (Bemerkung zu der Arbeit "Geochemie des Rheniums" von I. und W. Noddack.) E. Kronmann. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 161, Sept. 1932, pages 395-396. Kronmann furnishes proofs for his assumption that Re accumulates in rocks which are rich in C and also contain S. See also *Metals & Alloys*, Vol. 2, Nov. 1931, page 241. EF (1)

The Properties of Wires and Simple Straight Springs. Floyd A. Peyton & George R. Moore. *International Journal of Orthodontia & Dentistry for Children*, Vol. 19, Aug. 1933, pages 779-794. An investigation has been made of some of the physical properties of wrought Au alloy wires used in orthodontic procedure. The microstructure of these wires has also been observed. A precise method to measure the flexibility, that is the displacements and pressure, of auxiliary springs has been described, using the cathetometer as the measuring instrument. The results of measurements on different spring designs and the effect of wire diameter and spring length have been reported, using the following experimental conditions: (a) simple cantilever spring with concentrated load, (b) reflex spring with single concentrated load, (c) uniformly loaded reflex spring, (d) certain designs of practical appliances. Experimental data and discussions have been presented for all the springs studied. A correlation of the data with spring design, and with calculated values has also been given in several cases. Data have been presented in tables and graphs which give the composition and physical properties of 6 different wires, to demonstrate the displacement relationships of simple cantilever springs (1) when given varying heat treatments (none; quenched from 700° C.; oven-cooled), and (2) when formed from different materials. MAB (1)

Relation Between Structure and Properties of Solids, Especially Between Structure and Catalytic Activity. (Über den Zusammenhang zwischen Struktur und Eigenschaften, insbesondere zwischen Struktur und katalytischer Aktivität von Festkörpern.) Erich Pietsch. *Metallwirtschaft*, Vol. 12, Apr. 16, 1933, pages 223-224. A review of work done by the author and others, given in 17 references, on the relation between the effect of reagents on metals and their structure. The effect of grain size and strains in steel on its rate of corrosion, the relation between composition and catalytic activity of Pb-Tl alloys, the existence of the compound $PbTl_2$, the activation of Fe by Al_2O_3, and the relation between structure and properties of Cu-Au alloys are discussed. CEM (1)

Molybdenum: Its Mining, Milling and Uses. Alan Kissock. *Mining & Metallurgy*, Vol. 14, Apr. 1933, pages 181-182, 189. From a paper read before the New York section of the A. I. M. M. E. Largest deposits of Mo are located at Climax, Colo., and Questa, N. M. Ore reserves are estimated at about 80,000,000 tons of an average recoverable content of from 8 to 9 lbs. of metallic Mo. Describes method of mining and its metallurgical uses. Largest present tonnage application of Mo is in highly stressed automotive structural parts. Relatively recent use of Mo is in gray, white, chilled and malleable cast Fe, either alone or with Cr or Ni. Chemical salts of Mo are used in color industry. VSP (1)

A Precise Determination of the Thermal Diffusivity of Zinc. Richard H. Frazier. *Physical Review*, Vol. 43, Jan. 1933, pages 135-136. Results are given of tests to determine with precision the thermal diffusivity of a very pure (99.997%) sample of Zn. The over-all probable error is shown to be 0.13%. Method of test was presented in detail in a former paper. Results of other investigators on many properties of Zn are summarized in Circular of the Bureau of Standards, No. 395, Zinc and Its Alloys. WAT (1)

Thomson Effect of Crystalline Substances. Yositosi Endo. *Report Aeronautical Research Institute, Tokio Imperial University*, Vol. 7, July 1932, pages 115-149. From the calculation of the work against the internal electromotive force as well as the energy of electrons dissociated in metal, the formula for the Thomson effect has been obtained. This formula was applied to the case of Cu, Ag, Au, and Pb, compared with Borelius observed values, and the percentage of dissociated electrons estimated. GTM (1)

Conversions of Solid Metal Phases. IV. Kinetic Curves of a Precipitation Phenomenon. (Ueber Umwandlungen von festen Metallphasen. IV. Kinetische Kurven eines Ausscheidungsvorgangs.) U. Dehlinger. *Zeitschrift für Physik*, Vol. 79, No. 7/8, 1932, pages 550-557. A system of differential equations is derived by integration of which characteristic resistance effects found in Al_2Zn_3 in refining can be expressed. Ha (1)

Resistance Anomaly of Pure Bismuth (Die Widerstandsanomalie des reinen Wismuts) C. Drucker. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 162, Nov. 1932, pages 305-317. Resistance measurements on highly pure Bi wires corroborated previously found anomalies which could be connected with the temperature at which the wires were made. Temperature changes produce partly reversible partly permanent transitions. The transformations occur at certain temperatures as well as in temperature intervals. EF (1)

Sodium. H. N. Gilbert, N. D. Scott, W. F. Zimmerli & V. L. Hansley. *Industrial & Engineering Chemistry*, Vol. 25, July 1933, pages 735-741. The more important industrial uses of Na are mentioned briefly. Its physical and chemical properties are given, and suggestions of safe and convenient methods for using Na in chemical reactions, as well as the precautions necessary to prevent accidents in handling and storing, are presented. While the discussion of methods of application centers around laboratory procedure, it is believed that the chemical engineer faced with problems of plant design and operation involving the use of Na will be able to apply the methods given to his needs. 19 references. MEH (1)

The Freezing Point of Iridium. F. Henning & H. T. Wensel. *Bureau of Standards Journal of Research*, Vol. 10, June 1933, pages 809-821. Ratio of brightness for red light of a black body immersed in freezing Ir to that of a similar black body immersed in freezing Au was measured both directly and indirectly. Indirect method consists in determining the ratio of brightness at the Ir and Pt freezing points and calculating the result from the previously determined Pt to Au ratio. The two methods, agreeing with each other within experimental error yielded a value for the Ir to Au ratio of 4380 at wave length 0.652 μ. This fixes the freezing point of Ir on the International Temperature Scale as 2454° C. WAT (1)

Structural Phenomena Observed on Bi and Sb (Über strukturelle Besonderheiten beim Wismut und Antimon) A. Schulze. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 165, July 1933, pages 188-194. Dilatometric, electrical and microstructural investigations on Bi of 99.99% purity revealed that there are no allotropic transformations at 75°C. or between 100° and 150°C. Impurities result in discontinuities on physical property curves erroneously interpreted as transformations (Al, Zn). Resistance measurements on Sb with 3x10-4 impurities confirmed anomalies previously observed on Bi (C. Drucker. *Zeitschrift für physikalische Chemie*, Abt. A, Vol. 162, Nov. 1932, pages 305-317), which are ascribed to mechanical deformations due to elastic displacement of adjacent crystallites. The anomaly becomes more pronounced with falling temperatures due to increasing strain hardening. The disappearance of this phenomenon on tempering is caused by recrystallization or crystal recovery. The identical behavior of Bi and Sb is pointed out. EF (1)

The Metallurgy of Magnesium (Die Metallurgie des Magnesiums) R. Hoffmann. *Die Metallbörse*, Vol. 22, Nov. 5, 1932, pages 1421-1422; Nov. 12, 1932, pages 1453-1454; Nov. 19, 1932, pages 1485-1486; Nov. 26, 1932, pages 1517-1518; Dec. 1932, page 1551; Dec. 17, 1932, page 1615. A literature review comprising history, physical and chemical properties, production possibilities including reduction of Mg chloride by Na or Al, reduction of MgO by C at elevated temperatures, electrolysis of molten chlorides, electrolysis of MgO dissolved in molten Mg-fluoride, electrolysis of aqueous solutions, electrolysis of Mg-sulphide, commercial Mg brands, production and prices, 153 references. About 60% of the world production of 6000 tons/annum is utilized for castings, 18% in powder form, 4.8% as strip and wire, 7.5% for alloy purposes and the balance for sheets, tubes, chips, etc. EF (1)

Some Properties and Uses of Rhenium. (Dvi-Manganese.) J. G. F. Druce. *Industrial Chemist*, Vol. IX, July 1933, page 244. 12 references. A review of the literature giving important chemical properties, methods of preparation and uses. RAW (1)

The Pressure Coefficient of Resistance of 15 Metals Down to Liquid Oxygen Temperatures. P. W. Bridgman. *Proceedings American Academy of Arts and Sciences*, Vol. 67, Dec. 1932, pages 305-343. Describes technique and experimental procedure before giving a detailed presentation of data. Gas used as pressure medium was He. It can be said that pressure coefficient of resistance increases somewhat numerically at low temperatures. Attention is called to fact that with exception of Ni, which is anomalous in other respects, the metals concerned which have shown a numerical decrease of coefficient at low temperatures are those which are known to be least pure. Co and Ta in particular are of inferior purity and investigated only because they exhibit the phenomenon of supra-conductivity. With regard to the other metals, there is no correlation between the magnitude of the change of pressure coefficient with temperature and other properties. A table presents the average pressure coefficient of resistance up to 7000 kg./cm.^{2} as a function of temperature as low as -182.9° C. Kz (1)

Beryllium: Developing Its Use in Industry. W. H. Bassett. *Mining & Metallurgy*, Vol. 14, May 1933, pages 227-228. First commercial production of Be in U. S. was by Kemet Laboratories, and Siemens & Halske in Germany. Principal source of Be is beryl (Al_2O_3, 3 BeO, 6 SiO_2) containing a maximum of 5% Be. Recent investigations indicate that pure Be has the same hardness and mechanical properties as pure Fe. Under ordinary exposure Be becomes covered with a light film of oxide. Alloys of Be with Al and Mg have been successful. Study of Be-Cu alloys was made by author in 1926. Be-Cu can be cold rolled up to about 2.50 to 2.75% Be. Beyond this it can only be hot rolled. Commercial working of Be-Cu of 2.75% Be is practically impossible. To soften the alloy it must be quenched from temperature of about 800° C. Heat treatment for hardening the soft annealed material is 300° C. for 2 hours and for cold worked 275° C. Corrosion resistance of Be-Cu is equal to Cu-Sn bronze. VSP (1)

The Atomic Weight of Less Volatile Potassium Prepared by Hevesy. Gregory P. Baxter & Chester M. Alter. *Journal American Chemical Society*, Vol. 55, Aug. 1933, pages 3270-3271. The atomic weights of common K and heavy K concentrated by ideal distillation by Hevesy and Lögstrup have been found to be 39.096 and 39.109, respectively. MEH (1)

Elasticity Constants of the Aluminum Monocrystals (Elastizitätskonstanten des Aluminiumeinkristalls) E. Goens. *Annalen der Physik*, Series 5, Vol. 17, June 1933, pages 233-242. Several Al monocrystals were subjected to tension and torsion and from it the numerical values for the 3 principal elasticity moduli of the cubic crystal determined. It was found that the elastic anisotropy is much less in the Al than in other cubic monocrystals. Ha (1)

The Isotopes of Uranium, Thorium and Thallium. Roy Goslin & Fred Allison. *Physical Review*, Vol. 43, Jan. 1933, pages 49-50. Magneto-optic method shows 8 isotopes for U, Th and Tl. WAT (1)

Lead Isotopes. Edna R. Bishop, Margaret Lawrenz & C. B. Dollins. *Physical Review*, Vol. 43, Jan. 1933, pages 43-46. Magneto-optic methods show that Pb has 16 isotopes. All 16 isotopes were found in C. P. U and Th salts. WAT (1)

Radium Isotopes. Edna R. Bishop & C. B. Dollins. *Physical Review*, Vol. 43, Jan. 1933, page 48. Magneto-optic method shows that Ra had 4 isotopes. Probable masses in order of decreasing abundance are 226, 228, 230 and 232. WAT (1)

A Study of the Isotopes of Cobalt by the Magneto-optic Method. T. R. Ball & Stancil S. Cooper. *Journal American Chemical Society*, Vol. 55, Aug. 1933, pages 3207-3210. Two new isotopes of Co are reported. They are lighter than the 59 isotopes reported by Aston and probably have masses of 57 and 58. The 59 isotope is by far the most abundant and the 57 and 58 follow in order. MEH (1)

Lead. Issued by Imperial Institute, Mineral Industry of the British Empire and Foreign Countries. His Majesty's Stationery Office, London, 1933. Paper, 6 × 9½ inches, 253 pages. Price 4s. Geological data on world deposits of lead ores, economic data on production and prices, with brief comment on metallurgical and chemical facts of the lead industry. Both the text and the bibliography have been brought up to date. H. W. Gillett (1)-B-

Bismuth Isotopes. Fred Allison & Edna R. Bishop. *Physical Review*, Vol. 43, Jan. 1933, page 47. Magneto-optic method shows that Bi has 14 isotopes. WAT (1)

The Effect of Tension on the Electrical Resistance of Single Antimony Crystals. Mildred Allen. *Physical Review*, Vol. 43, Apr. 1933, pages 569-576. Adiabatic tension coefficient of resistance of single Sb crystals has been determined for various orientations. Since Sb crystals have the same symmetry as Bi, the curves connecting the coefficient with the primary and secondary orientations have the same general shape as in the case of Bi and again uphold the theory put forth by Bridgman. The observed values of the coefficients for Sb when the tension and current are parallel to the trigonal axis and perpendicular to it are different both in magnitude and in sign, whereas in the case of Bi the 2 were both negative and very nearly equal in magnitude. The 6 coefficients necessary completely to determine the behavior of the resistance when deforming forces are applied to the Sb crystals have been found (1) without correcting for strain and (2) correcting for the changes arising from the strain produced by the tension. The procedure used is briefly outlined. WAT (1)

Gallium (Das Gallium) *Die Metallbörse*, Vol. 23, Feb. 18, 1933, page 211. The price of Ga has been reduced 10% during the last year due to improvement in the production process. A future is predicted in the field of thermometer technique. Ga should furthermore replace Hg in rectifiers. The higher price is not so important since these apparatuses can run at higher current intensities when employing Ga. Since Ga is non-poisonous, it promises to be a valuable alloy element in dentistry. Favorable results were already secured at a German university. Ga forms eutectoids with Zn and Sn. It is insoluble in Hg, but the solubility in other metals has so far been established up to 5% in Pb, 11% in Bi, 13% in Cd. Physico-chemical data are given and the chemical behavior of Ga is briefly outlined. EF (1)

What Are Lüder's Lines? *Shipbuilding & Shipping Record*, Vol. 41, Mar. 23, 1933, pages 289-290. Discussion on lines which appeared in many parts of structure of S.S. "Nurtureton" which had been highly stressed. It is shown that these lines are Lüder's lines and resulted from the particular plates being stressed beyond their yield point and that the metal had started to fail through shear stresses. It is stated that this is first case of such lines appearing in a ship structure. JWD (1)

PROPERTIES OF NON-FERROUS ALLOYS (2)

A Study of Some Properties of Light Rollable Alloys. A. F. Bielov. Gosudarstvennoe Naouchno-Techniсheskoe Izdatelstvo, Moscow, 1933. Paper, 6 x 8¾ inches, 48 pages. Price 1.20 roubles. (In Russian.) Influence of temperature and time of heating, speed of cooling and the rate of aging was investigated in a series of alloys corresponding to usual commercial analyses of duralumin, superduralumin (4.89 Cu, 1.18 Si, 0.60 Mn, 0.67 Mg), Scleron, Constructal and Lautal. Physical properties are given for alloys both cast and rolled into sheets. 91 references. (2) -B-

Critical Considerations on the Aging Effects in Zinc Die Castings with Special Reference to the Mechanical Properties of Cast Iron (Kritische Betrachtungen über die sogenannten "Alterungserscheinungen" bei Zinkspritzguss, unter besonderer Berücksichtigung der mechanisch-technologischen Eigenschaften von Gusseisen) Willi Claus. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, July 9, 1933, pages 286-288. Zn die castings owe their increasing use to the following properties: (1) Cheapness combined with high accuracy of dimensions, inexpensive working. (2) excellent mechanical properties. A disadvantage of these alloys is the aging effects, caused by (1) the gradual disintegration of undercooled β-crystals, (2) intercrystalline oxidation, (3) gradual coagulation of newly formed α- and γ-crystals. The methods of avoiding this effect are discussed, foreign inclusions (Pb, Sn, Cd) and proper cross-sections play the most important role. The purity of Zn die cast alloys has been so greatly improved in recent years that the mentioned detrimental occurrences have been eliminated. Changes in length during a year are so small that detrimental effects during use need not be feared. The static mechanical properties increase with time, the dynamic properties are much superior to cast Fe even after 60 weeks of aging. 6 references. GN (2)

Effect of Composition on Bearing Alloys (Influence de la Composition sur les Alliages de Frottement) C. Upthegrove. *Bulletin de l'Association Technique de Fonderie*, Special Number, July 1932, pages 210-236. See "Bearing Properties Affected by Variations in Composition," *Metals & Alloys*, Vol. 3, Feb. 1932, page MA 30. FR (2)

$AuCu_3$ Inversion (Beiträge zur Kenntnis der $AuCu_3$ Umwandlung) W. Stenzel. *Die Metallbörse*, Vol. 22, Sept. 3, 1932, page 1135. Electric resistance, tensile curves of wires, strain hardening curves of single crystals and X-ray investigation showed that transformation of $AuCu_3$ takes place over intermediary phases. EF (2)

The Properties and Application of Nickel Bronzes. J. McNeil. *Mechanical World & Engineering Record*, Vol. 91, June 10, 1932, pages 562-565. The compositions of 5 bronzes with varying Ni contents are presented in a table. The influence of the increase of Ni content on the physical properties of the bronzes is summarized showing an improvement in elastic limit, tension and compression, yield point and ultimate strength up to an optimum Ni content, without loss of ductility. The melting point increases approximately 6.6° C. per 1% Ni when it replaces Cu and 18° C. when replacing Sn. Ni additions increase the fluidity and yield castings of greater density because of the tendency to minimize the presence of shrinkage cracks. The grain size was reduced one half due to 1.5% Ni. The action of Ni in preventing Pb segregation in Pb bronzes is attributed to a greater rapidity of setting when the metal enters the mold and to an increase of solubility of Pb in molten Cu. Various applications of Ni-bronzes are discussed giving the chemical and physical properties of different alloys. High Ni-content bronzes with Ni ranging up to 70% are highly corrosion resistant. Kz (2)

Workability of High Brass Sheet Influenced by Hardness, Ductility and Grain Size. M. H. Medwedeff. *Metal Progress*, Vol. 23, Feb. 1933, pages 18-22. 2 kinds of easily worked alpha brasses are in common use. Cartridge brass of low impurity content and high brass, S.A.E. 70, of higher impurity content. Cartridge brass may be more severely worked than high brass but costs more. Hardness tests are used as a cheap measure of drawability, but must be standardized by manufacturer and consumer to obtain uniform results. Hardness tables of Rockwell B & F, 1/16" ball, 100 and 60 kg. loads, on single sheets of various tempers and gage of brass are given. Tests on sheets less than 0.020" are unreliable, so elongation must be specified. 20 to 45% elongation is required for a severe draw. "Orange peel" surface after severe drawing is due to coarse grain. Fine-grained brass can be polished before plating with 30% saving in time. Provision for grain size should be included in specifications. 3 micrographs show coarse, medium and fine grain brasses. German silvers are not as susceptible to grain growth and tarnish less than brass, but harden more in working and cost more. Pb up to 2% is added to brasses to gain machinability at the expense of a corresponding amount of ductility. For swaging, Pb content should not exceed 1.5%. The Cu-Zn ratio must be maintained at 61:37% or alpha and beta constituents will give high work hardening properties. WLC (2)

Melting Points of Some Binary and Ternary Copper-rich Alloys Containing Phosphorus. W. Earl Lindlief. *Metals & Alloys*, Vol. 4, June 1933, page 85-88. 5 references. An investigation of melting points of alloys of Cu and P, Cu-Si-P, and Cu-Zn-P, up to 12% P has been made. The liquidus of the equilibrium diagram of the Cu-P system given by the author differs somewhat from that of Heyn and Bauer, the maximum difference being 50° C. at 6.5% P. The eutectic temperature was found to be 714° C. and P content 8.38%. Tentative diagrams of the liquidus of parts of the Cu-Si-P and Cu-Zn-P systems for Cu-rich alloys are given. WLC (2)

Die-casting. F. A. Livermore. *Mechanical World & Engineering Record*, Vol. 93, Feb. 24, 1933, pages 165-167. Advantages of die-castings are discussed besides the metals used for castings to which brass has been added lately. Gating, venting, and general construction of the die are dealt with. To ensure economic production of small die-castings, the minimum wall-thickness and minimum hole diameter should be known. Engraving and the casting of screw threads and shrouded gear teeth is touched upon. Cr-V steel is preferred as material for dies. Dowel-pins and small plain cores are made from tool steel. To facilitate the removal of the casting and to protect the die-faces a mixture of graphite, lard-oil, and beeswax should be used for lubrication of the die surface. Kz (2)

Characteristics of Certain Casting Aluminum Alloys, in Relation to Their Chemical and Structural Composition. (Sulle caratteristiche di alcune leghe di Al da fonderie, in funzione della loro composizione chimica e strutturale.) C. Panseri. *Alluminio*, Vol. 1, Sept.-Oct. 1932, pages 279-315. An extended study of characteristics and properties of Al alloys of 3 types: (1) high Cu alloys (Cu 10-20%); (2) high Si alloys (hypereutectic, Si 14-20%); (3) special alloys of Y type, and magnalite (Cu 4%, Ni 2%, Mg 1.5%). Their macro- and microstructure, as influenced by method of casting, and heat-treatment, are discussed. Then a number of systems, as determined by various authors, are reproduced. Thus, diagrams for systems Al-Cu, Al-Mg-Si, Al-Cu-Mg-Si, including special system where Mg_2Si and $CuAl_2$ are present simultaneously, influence of Ni on solubility of Cu and Mg_2Si, and of Fe, and Ti, are reviewed. Methods of heat treatment are discussed. Applicability of these alloys in special cases, as in pistons for motors and Diesel engines are discussed. AWC (2)

Directional Properties in Cold-Rolled and Annealed Commercial Bronze. Arthur Phillips & Carl H. Samans. *Metal Stampings*, Vol. 5, Oct. 1932, page 598. Abstract of a paper read before the American Institute of Mining & Metallurgical Engineers. See *Metals & Alloys*, Vol. 4, Apr. 1933, page MA 97. MS (2)

PROPERTIES OF FERROUS ALLOYS (3)

Effect of Normalizing on the Grain Structure and Physical Properties of Automobile Sheet Steel. William F. McGarrity & H. V. Anderson. *Transactions American Society for Steel Treating*, Vol. 21, Feb. 1933, pages 139-154. See *Metals & Alloys*, Vol. 3, May 1932, page MA 124. WLC (3)

Relation of Magnetic Properties, Especially of the Coercive Force, to the Structure of Alloys and the Development of New Magnetic Alloys. (Über die Beziehungen der magnetischen Eigenschaften, insbesondere der Koerzitivkraft zum Gefügeaufbau der Legierungen und die Entwicklung neuartiger Magnetlegierungen.) W. Köster. *Die Metallbörse*, Vol. 22, Sept. 3, 1932, page 1135. See *Metals & Alloys*, Vol. 4, Apr. 1933, page MA 99. EF (3)

On the High Strength Cast Iron. James A. Rabbit & Tadayoshi Fujiwara. *Journal Society of Mechanical Engineers Japan*, Vol. 36, Mar. 1933, pages 177-183. Paper read before the Special Meeting of the Society of Mechanical Engineers at Osaka, Nov. 3, 1932. The authors demonstrate the strength limitation of plain cast iron and show that the use of alloys by a special melting process or heat treatment will extend the range of composition of cast iron to produce a maximum strength. It is indicated that the maximum strength obtainable in plain iron is 28-32 kg./mm.², and it is pointed out that cast iron of a strength from 35-44 kg./mm.² can be obtained by methods described. The importance of the principal alloying elements (Ni and Cr) for the production of high strength cast iron, not only because of the effect upon the physical properties, but also because of the modifying characteristics, is shown. Kz (3)

On the Change of Properties of Die Steels Due to Heat Treatment. Takejiro Murakami & Atsuyoshi Hatta. *Kinzoku no Kenkyu*, Vol. 10, Aug. 1933, pages 321-364. The change of the transformation points of 6 commercial die steels, i.e., 1 non-alloyed high C steel (2.31% C), 1 low Cr-high C steel (1.91% C, 1.56% Cr), 3 high Cr-high C steels (1.83% C, 12.21% Cr; 1.98% C, 12.64% Cr; 2.71% C, 14.35% C), and 1 W-Cr steel (1.59% C, 1.77% Cr, 8.14% W), has been studied by means of the magnetic analysis and differential dilatometric measurement. The measurements were made on the hardness and the abrasion loss of these steels after several heat treatments under the room temperature, and the impact hardness and the impact value at the high temperature; the microstructure of these steels has also been examined. With both the high C steel and the low Cr-high C steel, the change of transformation points due to the cooling rate or the maximum heating temperature is not so marked, while with the high Cr-high C steels and the W-Cr steel, the change is conspicuous. The difference of the hardness among these steels in their furnace-cooled condition is slight, but that of the air-cooled state is great, according to the composition of the specimen and the maximum heating temperature. The high Cr-high C steels and the W-Cr steel are readily hardened by the air-cooling from above 900°. The high Cr-high C steels are markedly hardened after oil-quenched, and the maximum hardness can be obtained by quenching from 1000°. The hardness of the high C steel after oil-quenching is less than that of the other steels. With the low Cr-high C steel and the W-Cr steel, the hardness markedly decreases as the quenching temperature rises from 900° to 1100°, owing to the increase of the residual austenite. These steels with the low hardness value show marked increase of hardness, i.e., "the secondary hardening" on tempering. The same phenomenon is observable in the high Cr-high C steels which are oil-quenched from 1150°. The values of the hardness measured at several high temperatures and those at room temperature after being cooled from these temperatures, respectively, show a parallelism. The abrasion loss is small with the specimens having the large value of hardness. The impact value of these steels tested is generally small, especially with those of the oil-quenched, nevertheless it increases as the testing temperature rises. TM (3)

Martensitic Cast Iron. (Ueber martensitisches Gusseisen.) R. Hanel. *Die Giesserei*, Vol. 19, Nov. 25, 1932, pages 479-480. See *Metals & Alloys*, Vol. 4, July 1933, page MA 206. Ha (3)

Manufacture and Mechanical Properties of Spring Steels. (La fabrication et les proprietes mecaniques des aciers a ressort.) *Genie Civil*, Vol. 102, Mar. 1933, page 238. Abstract of paper by Houdremont & Bennek in *Stahl und Eisen*, See "Spring Steels," *Metals & Alloys*, Vol. 4, July 1933, page MA 206. JDG (3)

Metallurgical Considerations on the Recent Advances in Alloying Technique with Special Reference to Special Cast Irons and Steels and Their Future Economic Use in Tool, Machine Tool and Machine Construction. (Metallurgische Betrachtungen über die neueste Entwicklung in der Legierungstechnik unter besonderer Berücksichtigung der neuesten Gusseisen- Spezial- Legierungen und Sonderstähle sowie ihrer künftigen wirtschaftlichsten Anwendungsmöglichkeiten im Werkzeug-, Werkzeugmaschinen- und Maschinenbau.) J. F. Kesper. *Maschinenkonstrukteur-Betriebstechnik*, Vol. 66, June 10, 1933, pages 77-81. Discussed are: (1) Special steels for high temperature service. Mo and W are most effective in improving the hot tensile properties of C-Ni and Ni-Cr steels. According to investigations of the Witkowitz steel plant a boiler steel with .25% C and .6% Mo shows the following properties:

	at 20° C.	550° C.
Tensile Strength kg./mm.²	75%	43%
Yield Point kg./mm.²	50	41
Elongation in 100 mm.	14	18

(2) Special steels: In recent times 1-2% Mo are added to high speed steels, thus increasing hardness and promoting uniformity of carbides, higher life of cutting edge is attained. Steels with .20-40% Mo are used for rolling mill rolls, other Mo steels for automobile valves and other automobile parts, rods in airplanes (good welding properties), Cr-Mo steels for barrels of high speed fire arms, and ball bearings, Mn-Mo steels for rails and locomotive tires. (3) Special cast steels and irons: Mo has successfully been used in cast steel. A steel with .25-.35% C, .90-1.25% Mn and .25-35% Mo, for instance, shows the following properties after quenching in water from 870° C. and annealing at 675° C: T.S.: 70 kg./mm.², Y.P.: 53 kg./mm.² reduction of area: 60.5%, elongation in 50 mm.: 26%, fatigue limit: 36.5 kg./mm.² upon air hardening steel with 1.35% Mn, .35% Mo, .60% Cr and 1.15% Ni attains values which steels of other composition attain only upon oil or water hardening. For instance: T.S.: 80 kg./mm.², Y.P.: 60 kg./mm.², reduction of area: 40%, elongation in 50 mm.: 20%. Mo brings about similar improvements of the mechanical properties of cast iron. GN (3)

Effect of Hot Rolling and Final Treating Temperature on Strength and Structure. (Hallfasthetsegenskapernas och strukturens beroende av varmbearbetningsgraden och slutvalsnings-temperaturen.) Klas-Erik Johansson. *Jernkontorets Annaler*, Vol. 117, June 1933, pages 288-322. As a result of the survey it is concluded that the breaking limit and Brinell hardness are only slightly affected, while the proportionality and elastic limits are greatly changed. A final working temperature near the Ar_3 point usually gives the best mechanical properties. While a high working temperature (1200° C.) has greater influence, it is seldom used in practice. The stretching limit is raised considerably when a low temperature is used. A high degree of working usually gives a finer grain structure but the mechanical properties are but little affected above the Ar_3 point. Below this point, recrystallization may take place and quality may be sacrificed. With regard to hard steels, the literature gives no clear cut information. 30 references. HCD (3)

Iron or Permalloy? K. V. Grigorov. *Journal tekhnicheskoj fiziki*, Vol. 2, June 1932, pages 21-24 (In Russian). After a survey of recent data on magnetic properties of permalloy and of purest electrolytic iron, the advantages of the latter are pointed out, and the necessity of the study of methods of commercial production of pure iron is stressed. LI (3)

CORROSION, EROSION, OXIDATION, PASSIVITY & PROTECTION (4)

Resistance of Materials Used in Boiler Construction. Investigation on Cause of Failures in Water Tube Boiler Plates (Une Etude d'Ensemble sur la Résistance des Matériaux à Employer dans la Construction des Chaudières. Recherche des Causes d'Accidents des Toles de Chaudières Aquatubulaires) G. PARIS. *Chaleur & Industrie,* Vol. 13, July 1932, pages 475-478. (1) Aging: When a cold worked steel plate remains a long time at room temperature, its impact resistance decreases in consequence of aging effect. In such a brittle plate a crystalline orientation can be observed. Aging is hastened by heating at about 200° C. Annealing at 900°-950° C. suppresses the effect of cold working and aging can then occur. (2) Caustic brittleness: when alkali water is used intercrystalline fractures are frequently noted near rivets, the metal remaining quite sound close to the fractures. Explanations given for such failures are still contradictory. A high concentration of soda can be obtained in some capillary spaces in boilers under alternating expansion stresses. Sometimes even solid soda can be seen in such spaces. Fracture would then be due to corrosion of iron in those spots. It is possible to neutralize harmful effect of alkali water by suitable Na-sulphate additions. (3) Aspect of plate fractures with elongation and reduction of area do not appear in water tube boiler plate. Fractures without elongation are always localized near a weakened section: rivet hole, etc. . . . They have all the same aspect: they begin by capillary fissures which under stress, tend to open. Boiler plates can also be corroded by oxygen dissolved in water. Metal so attacked shows deep localized pin holes. (4) Macrographic aspect of plates. The macrographic study gives useful indications on the segregation but does not explain the causes of failures. (5) Micrographic aspect of plates. The micrographic study can show the grain size, laminated pearlite layers, recrystallization, intercrystalline fractures, inclusions, etc. FR (4)

The Wear of Cast Iron. F. K. NEATH. *Foundry Trade Journal,* Vol. 48, Mar. 23, 1933, pages 203-205. Summary of published work on this question enables us to classify effect on wear of Mn, S, P, etc., of work hardening and of annealing. The testing methods include rotating ring test, brake-shoe test, blunt drill test, abrasion test, etc. OWE (4)

Electrochemical Corrosion and Its Prevention (Die elektrochemische Korrosion und ihre Bekämpfung). KURT NIED. *Oberflächentechnik,* Vol. 9, Dec. 20, 1932, pages 253-255. Corrosion is, in majority of cases due to electrochemical processes. Nature of this process consisting in precipitation of a noble metal by a less noble metal (in potential series) from its solution is explained. Various means to suppress local currents due to such local elements and thus to suppress corrosion are reviewed and several patented processes described. Ha (4)

The Surface Film Theory of Passivity of Metals and Its Experimental Foundation (Die Bedeckungstheorie der Passivität der Metalle und ihre experimentelle Begründung) W. J. MÜLLER. *Verlag Chemie,* Berlin, 1933. Paper, 6x9 inches, 102 pages. Price 6 RM. Passivity by the formation of surface films is considered to follow naturally from the laws of Faraday, Ohm and Hittorf, and from Nernst's theory of metal potentials. Many examples are cited and curves plotted showing rate of formation of films in accordance with physicochemical laws.

H. W. Gillett (4)-B-

Unexpected Corrosion of a Steam Turbine (Unerwartete Korrosion an einer Dampfturbine) KIRST. *Die Wärme,* Vol. 56, Jan. 7, 1933, page 12. Turbines which are in continuous use exhibit corrosion defects to a lesser extent than those idle each day for a couple of hours. Not only the blades but also the guide wheel of a tapped counter-pressure turbine showed severe corrosion attacks, which were traced to a stand-by valve for overload. This valve was not sufficiently tight. Steam leaked into the turbine and condensed on the cold interior walls resulting in corrosion effects. Even the labyrinth stuffing box was corroded. WH (4)

Contribution to the Study of Destruction Process of Gray Cast Iron by Acids. (Contribution à l'Etude du Processus de Destruction de la Fonte grise par les Acides.) L. F. Girardet & Tsou-Ren-Kou. *Bulletin de l'Association Technique de Fonderie,* Vol. 6, July 1932, pages 290-322. Paper before World Foundry Convention, Paris, 1932. Authors have studied behavior of gray cast Fe in usual concentrated or normally diluted acids. They have first qualitatively determined this action by following various stages with help of microscopy 1
(166 micrographs are given). This study has shown that corrosion is carried out by elementary cells which are formed between constituents and especially by the following cells: (1) Graphite-acid considered—ferrite/pearlite; (2) Fe_3P-acid considered—ferrite/pearlite. The action of each one is variable according to the conditions and can even be suppressed. Having noted the existing cells and their spontaneous evolution, authors have studied effect of additions which were supposed to act either on anodic or cathodic surfaces or on the escape of H bubbles and therefore were able to modify the functioning of cells: The following additions were made to the acids studied (1) matters increasing the tension of H evolving. (They lessen corrosion but have little effect with HNO_3 which does not produce H.) (2) Ions rendering the metal more "noble" (rate of corrosion is, at the 2
beginning, greater than with the acid without additions but decreases as the depth of the protective coating formed increases). (3) Matters increasing the viscosity of the liquid (Increasing viscosity by means of glycerine reduces the corrosion rate, however, with HNO_3, phosphide eutectic is strongly attacked owing to activity of Fe_3P-acid-pearlite cell). (4) Oxidizing matters which suppress the H evolving, i.e. depolarizing matters (they increase the e.m.f. of the graphite-acid-matrix cell accentuating its local action. With phosphoric acid, there is no cell formed with graphite, but the cell phosphide eutectic-phosphoric acid-pearlite possesses an appreciable e.m.f. and the eutectic acts as cathode like graphite in other cases). (5) Colloidal matters (corrosion process remains the same but corrosion rate is more or less decreased). The second part of the paper deals with the quantitative study of destruction of cast iron by normal acids and gives, in 3
each case, the dissolution rate as a function of time. Results, graphically recorded, agree with micrography. In the third part, authors have studied effects of structural changes—produced by varying heat treatments—on the corrosion rate. (Two kinds of cast iron, one with coarse and the other with fine graphite, were studied). General conclusions are as follows: (1) Any structural change which increases the number of elementary cells increases the corrosion rate. (2) Any structural change resulting from the modification of one or more constituents becoming more reactive increases the corrosion rate. FR (4)

Rapid Erosion Tests Clarify Wear of Metals. T. F. Hengstenberg. *Steel,* Vol. 91, Oct. 17, 1932, pages 21-23. An accelerated erosion test is described for comparing the erosion-resisting properties of various steels. Test pieces are in- 4
serted into the rim of an impeller disk which rotates at from 10,000 to 20,000 r.p.m. while the test pieces strike continuous jets of water twice each revolution. A few minutes of this test produce erosion effects equal to several years of average service. In general, erosion increases with speed of rotation and differences between individual steels become more marked as speed increases. JN (4)

Electrochemical Theory of the Corrosion of Metals. (Généralisation de la théorie électrochimique de la corrosion des métaux.) E. Herzog & G. Chaudron. *Chimie et Industrie,* Vol. 27, Special Number, March 1932, pages 351-359. Show analogies between function of piles and corrosion of metals. All methods permit reduction of piles, either cathodic or anodic polarization; a H overvoltage may be used to protect the metals. Pure metals are not necessarily the ones attacked 5
least. Iron and certain light alloys may be protected by certain additions of other elements. 31 references. MAB (4)

External Corrosion and Erosion of Boilers Caused by Leakage. E. INGHAM. *Mechanical World & Engineering Record,* Vol. 93, Mar. 10, 1933, pages 238-239. A leak at a part covered by brickwork is prone to cause extensive wasting, because the porous brickwork readily absorbs moisture and favors external corrosion. The amount of brickwork bearing against plates should be reduced to the minimum. Mending of different kinds of leaks is discussed. Wasting caused by leakage is mostly the result of chemical action and only occasionally caused by mechanical action. Kz (4)

Modern Ways of Rust-Proofing Steel. A. C. JEBENS. *Engineering Progress,* Vol. 13, Oct. 1932, pages 220-221. Of the total world output of 1766 million tons of metal between 1890 and 1923, 718 million tons have already been annihilated by rust. Brief summary of methods including paint, alloying, "Parkerizing," "Atrament," "Nasteco," "Tornesit," "Herolith," and "Ferroplatin." RHP (4)

Anodic Process Prevents Corrosion. ROBERT JOHNSON. *Electrical West,* Vol. 70, May 1, 1933, pages 158-159. Boeing Airplane Co., Seattle, Wash., treats all duralumin and Al parts of aeroplanes by anodic oxidation. Parts to be treated, acting as the anode, are suspended in a bath of 3% CrO_3 solution, which is agitated by air during the process. Cu conductors suspended in the bottom of the tanks are the cathodes. Temperature of the bath is maintained at 102° F. $\pm$ 2°. Voltage of current is raised from 0-40 volts during a 15-min. period. It is left at 40 volts for 35 min. then, in the next 10 min., it is raised to 50 volts, where it remains for the last 5 min. of the process. Coating is particularly resistant to corrosion and causes a closer adherence of paint. All steel parts are Cd plated. MS (4)

Steel without Rust. JOHN JOHNSTON. *Scientific Monthly,* Dec. 1932, pages 554-556. A popular treatment is given the losses due to rusting of steel, their prevention by surface coating and the new stainless steel alloys. The structure characteristics upon which the rustless property is based are described. Ha (4)

Metallurgy of Engine Valve Steels. J. R. HANDFORTH. *Heat Treating & Forging,* Vol. 18, Oct. 1932, pages 583-587; Nov. 1932, pages 638-641. From paper read before the Iron & Steel Institute. See *Metals & Alloys,* Vol. 4, Apr. 1933, page MA 103. MS (4)

Experience Gained on Low Pressure Turbine Blades in the Klingenberg Power Plant (Erfahrungen mit Niederdruckturbinen-Beschauflung im Kraftwerk Klingenberg) FR. GROPP & W. ELLRICH. *Elektrizitätswirtschaft,* Vol. 31, Sept. 30, 1932, pages 413-415. Further investigations and experiences on the most suitable material for turbine blading are presented. (See also *Elektrizitätswirtschaft,* Vol. 30, Oct. 1931, pages 589-592.) VSM steel shows erosion which will lead to failure after 50,000 hrs. in operation if the straight line course continues. The calculation is based on the assumption of a critical depth of 10 mm. The Ni brass shows only a slight increase of wear. The Krupp steel WF 100, the analysis of which is corrected as follows: 14.85 Cr, 12.75 Ni, 1.85 W, 67.53 Fe, 0.55 C, 1.6 Si, 0.85 Mn, 0.01 P, 0.01 S, shows like the rest of the materials employed a rather sudden increase of erosion which however starts comparatively late, i.e. not before about 4000 hrs. The writers hold that a highly polished surface displays great resistance towards erosion which however progresses at a rapid rate due to the roughening of the surface. The Mn steel strips on V5M show less pronounced erosion effects. But this is probably due to the less exposed location in the turbine. Checking on V5M turbine blades in a further power plant leads to the conclusion that stronger profiles must be applied besides proper selection of material with the aim of resisting wear by water. EF (4)

Corrosion in Steel Chimneys. J. S. GANDER. *Mechanical World & Engineering Record,* Vol. 92, Sept. 23, 1932, pages 291-292. With modern methods of heat recovery, and the consequent cooling of chimney gases, there is an increased tendency for aqueous and other vapors to condense within the length of the smoke stack and cause corrosion. Although painting with corrosion-resisting paint may not seem feasible, it has been done successfully with emulsified asphalt. In order to conserve the residual heat in the gases, a stack can be lined with concrete, a wire mesh attached to the steelwork being used as a support. Kz (4)

Weathered Steel Resists Corrosion. F. G. MARTIN. *Metal Progress,* Vol. 23, Apr. 1933, page 48-49. The carrying of cargo oil and sea water alternately in the double bottom tanks on British ships is referred to. The oil cargo was thought to be beneficial to the tank material for years, but recently a bad type of corrosion is evident from which grease or paint provide little protection. Montgomery's explanation of this corrosion is thought the most likely. It is, that shipyards which formerly stocked ship plates for some time prior to use now order them only as required and no opportunity for weathering with consequent detachment of mill scale is provided. Hidden moisture does corrosive work. WLC (4)

The Influence of Traces of a Salt of Tin in Acid Solution on the Rate of Corrosion of Mild Steel. T. N. MORRIS & J. M. BRYAN. *Transactions Faraday Society,* Vol. 29, Feb. 1933, pages 395-399. A metallic impurity of high over-voltage would if deposited on its surface have an inhibiting action on the corrosion of Fe by an acid. This effect is demonstrated. Paper deals (1) with effect on rate of corrosion of steel by a solution containing 5 g./l. of citric acid together with a varying amount of Sn as Sn citrate, and (2) with effect of varying H-ion concentration of solution of citric acid by means of sodium citrate, amount of Sn in a given volume remaining constant (4 mg./l.). Very small amounts of Sn have a powerful effect on corrosion, 2 parts per million being sufficient to reduce the rate by nearly one-half. Succeeding increments of Sn do not exert a corresponding inhibition, a form of behavior which seems to be characteristic of inhibitors. Inhibitors act most efficiently where there is evolution of H as bubbles. They do not oppose to the same extent the type of corrosion in which the H passes directly into solution. PRK + WAT (4)

Soil Corrosion of Pipe Lines. K. H. LOGAN. *Gas Engineer,* Vol. 57, May 1932, pages 255-259. Details on tests on soils of varying corrosive properties. All essential information can be found in Research Paper No. 363, U. S. Bureau of Standards. WH (4)

Some Observations On the Corrosion of Lead. A. H. LOVELESS, T. A. S. DAVIE & W. WRIGHT. *Journal Royal Technical College,* Vol. 3, Jan. 1933, pages 57-64. Rate of corrosion of unstressed lead at 50° C. with H_2SO_4 increases as concentration of acid increases from 30 to 96.5% and depends on coherence of film of lead sulphate formed by initial attack. Corrosion at higher temperatures up to 200° C. depends on concentration of acid, attack at concentrations below 93% being more marked at low temperatures, while with over 93% it is greater at high temperatures. Influence of stress up to 200 lbs./in.^{2} accelerates attack and is most noticeable when stresses exceed 100 lbs./in.^{2}, lead sulphate film showing numerous cracks. Corrosion with HCl at 15° and 100° C. and with concentrations up to 40% shows a distinct relationship between solubility of lead chloride in the HCl solutions. JWD (4)

Corrosion of Cast Iron Pipes Installed in 1885 (Zerstörung an Gussrohren der Nürnbergerursprungleitung von 1885) F. KRAUSS. *Gesundheitsingenieur,* Vol. 55, Feb. 20, 1932, pages 103-105. Investigations into failure of municipal pipe lines disclosed that local conditions of soil, particularly its high contents in sulphates and sulphides are responsible for the heavy corrosion pittings besides the occasionally high ground water level, which promotes electrolytic reactions, and injuries on the outside asphalt coating. The corrosion attack started exclusively from the outside. The defective parts of the line were replaced by centrifugally cast concrete tubes provided with an external bitumen shell. EF (4)

Anodic Polarization of Aluminum and Its Alloys as a Protection Against Corrosion. V. KROENIG & I. KASAKOV. *Tsvetnuie Metallui,* No. 4, Apr. 1932, pages 505-512. (In Russian.) Description is given of the anodic polarization methods used in Central Aero-Hydrodynamic Institute (Moskow). Some experiments showed that anodic polarization increases considerably the resistance of Al and duralumin to corrosion in sea-water. BND (4)

Theory of Passivity Phenomena XVIII. On Discontinuities During Anodic Passification (Zur Theorie der Passivitätserscheinungen XVIII. Über Schwankungserscheinungen bei anodischer Passivierung) WOLF JOHANNES MÜLLER. *Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse,* Abt. II b, Chemie, Vol. 142, No. 1/2, 1933, pages 26-37. Paper presented before the Society on Feb. 9, 1933, communicates experimental results on the passifying of Cu in saturated $CuSO_4$ solutions, Fe in 0.996 N H_2SO_4 and 1 N Na_2SO_4 solutions, and Pb in battery acid. When plotting the covering or film coating function H + L of the equation correlating the areal film development to time, a linear course was established in most cases, which result is in accordance with the experimenter's basic assumption concerning a constant film thickness δ during the passification process. In some cases, this linear course was absent. This phenomenon is ascribed to a change in the thickness of the film during the passification process. A flat "curve" corresponds to a small film thickness and a steep curve to a larger one. These results also shed some light upon fluctuations of the passification times which depend on the film thickness. The practical advantage of the discussed method of determining passifying effects is that the constants of the previously derived formulae can be established with appreciable accuracy. The experiments showed that passification laws hold true only within certain statistical ranges and that in case of passification determinations a great number of experiments are required. WH (4)

Peculiar Corrosion Attacks on Inside of Lead Sheaths for Long Distance Cables (Eigenartige Korrosionen auf der Innenseite der Mäntel von Fernsprechkabeln) O. HAEHNEL & H. KLEWE. *Elektrische Nachrichten Technik,* Vol. 8, Nov. 1932, pages 407-411; Dec. 1932, page 502. Lead oxide and peroxide and small amounts of Pb chloride were found as corrosion products in the pits on the inside of cable lead coverings and basic Cu carbonate on the Cu conductor. The outside of the Pb was in perfect condition. A new type of corrosion attack was established ascribed to an electrolysis between the Cu conductor and Pb sheath. The necessary quantity of moisture is evaluated. Metallographic investigations yielded a crystal growth up to 8 times of the crystal size of freshly made cable sheaths. The crystal size proved to be the larger the heavier the corrosion attack indicating the presence of minute cracks, intercrystalline embrittlement and a slow rate penetration of moisture which drastically cuts down the insulation properties of paper and permits the occurrence of electrolysis. A note is appended referring to the same type of corrosion also detected recently in the fields of heavy current technique referring to a d.c. cable of 220 volts provided with a jute serving, steel wire spiral and lead sheath. This cable failed in service after 30 years. WH (4)

Rust Preventers and Slushing Materials. E. E. HALLS. *American Machinist,* Vol. 76, Apr. 14, 1932, pages 491-493. Deals with temporary rust prevention. Discusses cleaning methods. Iron and steel test pieces were dipped in paraffin, cellulose lacquer, spirit varnish, oil drying varnish, non-drying oil varnish, light mineral oil, medium mineral oil, heavy mineral oil, thin mineral jelly, thick mineral jelly, lanolin, lanolin mixture 1, lanolin mixture 2, soluble oil. Test results are given for 1, 7, 21, and 28 days, exposure in atmosphere. Lanolin mixture 1 and 2 are the only coatings unaffected after 28 days. Cu and brass samples similarly treated were exposed under humidified conditions. Several coatings were unaffected at the end of 100 days. RHP (4)

Tantalum as Material for Laboratory Apparatus (Tantal als Werkstoff für Laboratoriumsgeräte) I. KOPPEL. *Die Naturwissenschaften,* Vol. 20, Dec. 9, 1932, page 910. Ta displays properties similar to Pt. Ta withstands diluted oxidizing and non-oxidizing acids, but is attacked by conc. HNO_3 and H_2SO_4 at 150° C. as well as by alkalies, HF diluted or concentrated, molten alkaline hydroxides and carbonates. Cu, Zn, Ni, Co, Ag, Au and Cd could be electro-deposited quantitatively on Ta electrodes in acid, ammonia or cyanide solutions. No suitable electrolyte could be found for Sn. After 150 electrolyses alternately made in acid Cu and ammonia Ni solutions, the weight loss of the Ta cathode amounted to only 0.02%. EF (4)

STRUCTURE OF METALS & ALLOYS (5)

Metallography & Macrography (5a)

Movie of Metals at High Heat. BRUCE A. ROGERS & LELAND R. VAN WERT. *Metal Progress,* Vol. 23, Feb. 1933, page 46. The method used in obtaining the movie "Surface Changes in Metals at High Temperatures" consisted of 3 modifications of ordinary photomicrographic methods. The sample was placed in a miniature electric furnace mounted on the stage and watched through a fused silica window. A motion picture camera without the lens was mounted in place of the camera box. A prism was placed between microscope and camera, permitting visual observation and photography. Water cooling was used on the outer shell of the furnace and H introduced for the prevention of oxidation. Magnification was 30 diameters. A half tone shows the layout. Sections of film show the A_3 transformation sweeping over a piece of Armco ingot Fe. WLC (5a)

Veining in Ferrite (Der Aederungsbestandteil im Ferrit) H. HANEMANN, A. SCHRADER & W. TANGERDING. *Archiv für das Eisenhüttenwesen,* Vol. 6, June 1933, pages 567-570. Etching with sodium picrate and with H_2 appeared to indicate the absence of iron carbide, nitride, or oxide in the veins. It was concluded veining through the juxtaposition of ferrite platelets differing in orientation and from the presence of traces of impurities. SE (5a)

Relation of Phosphorus to Copper and Silver. I (Ueber das Verhalten des Phosphorus zu Kupfer und Silber. I) K. W. FROEHLICH. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 6, Nov. 1932, pages 69-74. Ternary system Ag-Cu-P was closely investigated in order to elucidate influence of P on Ag-Cu alloys where it is used as deoxidation agent and, sometimes has injurious results. Systems Cu-P and Ag-P are investigated first, Cu_3P and AgP_2 are formed, eutectic point for Cu is at 707° C. with a content of 8.8% P, and for Ag at 877°-879° C. with about 0.96-1% P. If P is added to an Ag-Cu melt Cu_3P is formed but no AgP_2 as long as there is still free Cu. Melt can therefore be considered as a binary system Ag-Cu_3 P. Melting diagram of this alloy has eutectic point at 796° C. with 46.2% Ag and 53.8% Cu_3 P; this melt is extremely viscous, almost like tar. Conditions are more complicated in a melt where one constituent is present in excess, a ternary eutectic is then formed at 646° C. containing 17.9% Ag, 30.4% Cu as metal and 51.7% Cu_3 P (= 7.2% P). These results are applied for the explanation of certain defects in Ag sheet as used in the manufacture of jewelry; the micrographic structure shows irregularities which are due to improper treatment while still red hot. Ha (5a)

Secondary Hardness in High Speed Steel (Die Anlasshärte der Schnellarbeitsstähle) W. EILENDER, H. KLINAR & H. CORNELIUS. *Archiv für das Eisenhüttenwesen,* Vol. 6, June 1933, pages 563-566. By means of hardness, magnetic, and dilatometric tests on high speed steels and similar lower carbon alloys renewed evidence was obtained that secondary hardness in high speed steel is due to the breakdown of retained austenite to martensite during tempering. The increase in hardness of the lower carbon alloys on tempering was attributed to precipitation hardening. SE (5a)

Quenching Diagrams of the Iron-Carbon Alloys (Das Hartungsschaubild der Eisen-Kohlenstoff-Legierungen) H. ESSER, W. EILENDER & E. SPENLÉ. *Archiv für das Eisenhüttenwesen,* Vol. 6, Mar. 1933, pages 389-393. The magnetic as well as the thermal critical points during hardening were determined in gas quenching thin wires of pure iron-carbon alloys. Cooling rates from 100-15,000° C./sec. were obtained. Curves show the temperature ranges of the Ar' and Ar" points as influenced by cooling rate and carbon content. In eutectoid steel a critical cooling rate of about 150° C./sec. was required to give the Ar" point. In hypo and hyper eutectoid steels higher critical cooling rates were needed, about 350° C./sec. in a 0.20% C alloy, and 450° C./sec. in a 1.5% C alloy. The temperature of the Ar" point was lowered with increasing carbon content from about 400° C. for the 0.2% C alloy to about 75° C. in the 1.5% C alloy. SE (5a)

Microstructural Studies at Temperatures Up to 1100°C. (Gefügeuntersuchung bei Temperaturen bis 1100°.) H. ESSER & H. CORNELIUS. *Stahl und Eisen,* Vol. 53, May 18, 1933, pages 532-535. An apparatus is illustrated whereby the structure of a polished and etched metal specimen can be examined while it is heated in a vacuum of 0.0001 mm., up to 1100° C., and photographed during the course of any structural transformations; 15 micrographs/min. can be taken. Observations are described of the α-γ transformation of pure iron and carbon steel; the transformation of retained austenite to martensite in a quenched 2% C, 2% Mn steel; and the graphitization of white cast iron. The solubility of oxygen in electrolytic iron did not noticeably increase on heating to 1100° C. SE (5a)

Equilibrium FeO + Ni$\rightleftarrows$NiO + Fe in the Melt (Das Gleichgewicht FeO + Ni$\rightleftarrows$NiO + Fe in Schmelzfluss) W. JANDER & HANS SENF. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 210, Feb. 1933, pages 316-324. Applying the mass law to the equilibria between Fe and Ni between 1500° and 1800° C. certain discrepancies in the measured and calculated constants are observed which are too large to be attributed to errors. They can be explained by assuming that the constants change with temperature; this seems to be confirmed by the measurement that the solubility of both metals together was 0.1% at 1560° and 0.5% at 1790° C. Ha (5a)

Rate of Transformation in Solid Steel (Geschwindigkeit von Umwandlungen im festen Stahl) E. C. BAIN. *Archiv für das Eisenhüttenwesen,* Vol. 7, July 1933, pages 41-47. See "On the Rates of Reactions in Solid Steel," *Metals & Alloys,* Vol. 4, May 1933, page MA 140. SE (5a)

The Transparency of Sulphide and Oxide Inclusions in Steel (Om genomskinlighet hos sulfid- och oxidslagger i stal) C. BENEDICKS & H. LÖFQUIST. *Jernkontorets Annaler,* Vol. 116, Sept. 1933, pages 443-457. In microphotographs of oxide or sulphide slag inclusions, certain series of parallel lines are sometimes observed. These are shown to be due to interference phenomena on transparent wedge shaped slabs. By measuring the distances between the lines the refractive index may be calculated. For light of wave-length 0.53μ, the value of n for (Fe, Mn) O was found to be 2.1 ± 0.1 and for MnS, 2.4. HCD (5a)

Kinetics of Crystallization Phenomena (Zur Kinetik von Kristallisationsvorgängen) v. GOELER & G. SACHS. *Zeitschrift für Physik,* Vol. 77, 1932, pages 281-286. The crystallization theory of Tammann, namely that crystal nuclei originate in a melt according to statistical laws, is applied also to the crystallization of undercooled liquids and to the re-crystallization of worked metals; the temporal course of crystallization, number of grains and distribution of size of grains is derived from the theory. 13 references. Ha (5a)

Alloys of Iron Research. Part XI.—The Constitution of the Alloys of Iron and Manganese. MARIE L. V. GAYLER. *Iron & Steel Institute,* Advance Copy No. 7, Sept. 1933, 48 pages. This report contains the results of a detailed investigation of equilibria involving alloys of very high purity. Conventional methods, including X-ray examination, were used. The liquidus and solidus were found to be above those drawn by earlier investigators. The existence of a peritectic reaction between γFe and liquid to form γMn was confirmed. The peritectic at the Fe end was found to be at 1504° C. It extends from 1 to 8% Mn and the γphase at the peritectic temperature contains 6% Mn. The constitution of the solid Fe-rich alloys was not solved, but microscopic examination indicated that a phase other than α or γ was formed (the ϵphase reported by others?). The changes in the solid state for Mn-rich alloys were carefully determined. The γMn phase decomposes into γFe and βMn at 1028° C. over a range of composition of 64 to 72% Mn. The βMn phase decomposes into γFe and αMn at 600° C. over a range of 59 to 63% Mn. An appendix by C. Wainwright gives the results of X-ray analyses of Mn-rich alloys quenched from different temperatures. 20 references. JLG (5a)

Results Like These Are Obtained Only With

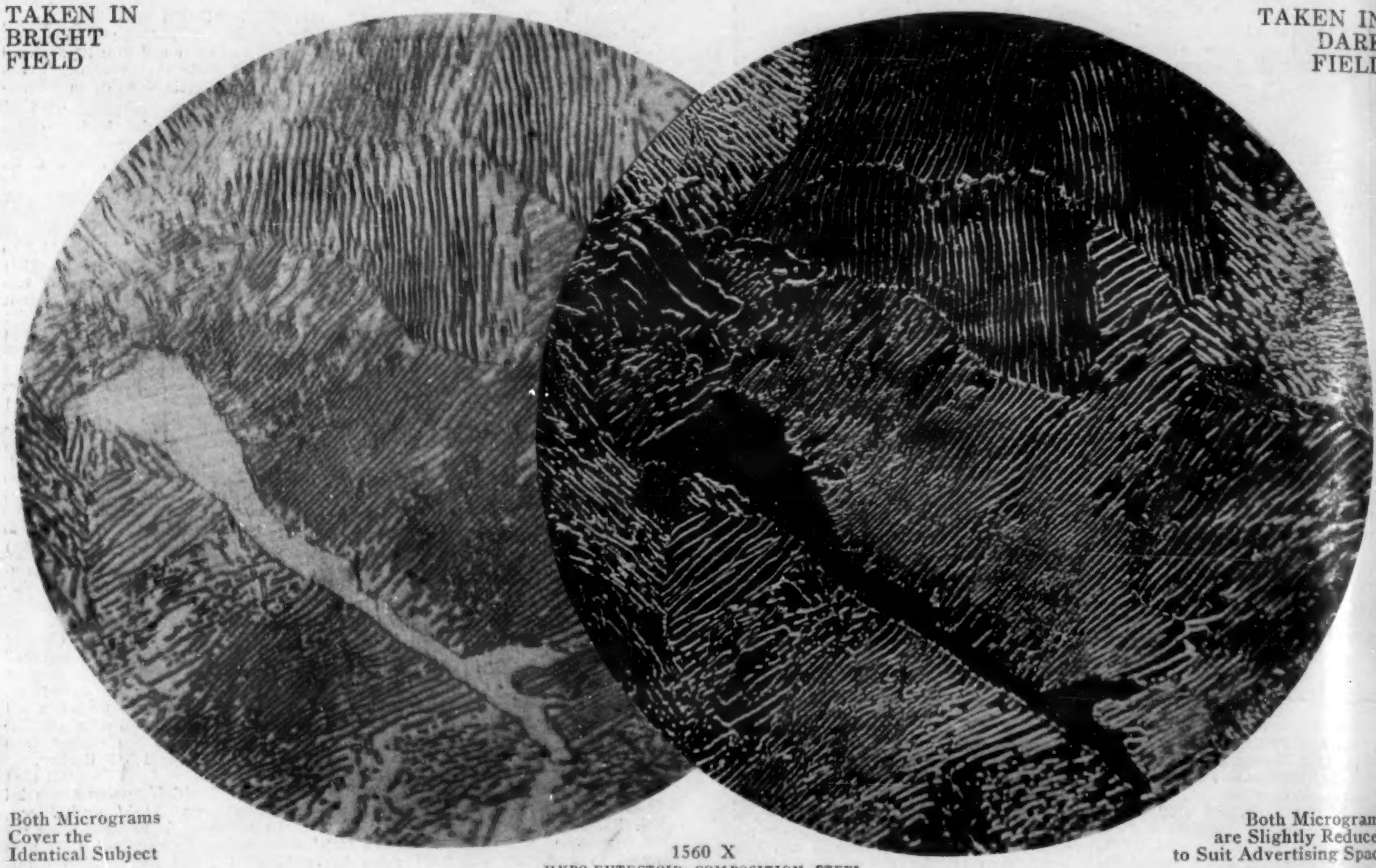
LEITZ *New* MICRO-METALLOGRAPH

LEITZ DARKFIELD EQUIPMENT AND LEITZ NEW OBJECTIVES

(Corrected for Infinity)

TAKEN IN BRIGHT FIELD

TAKEN IN DARK FIELD



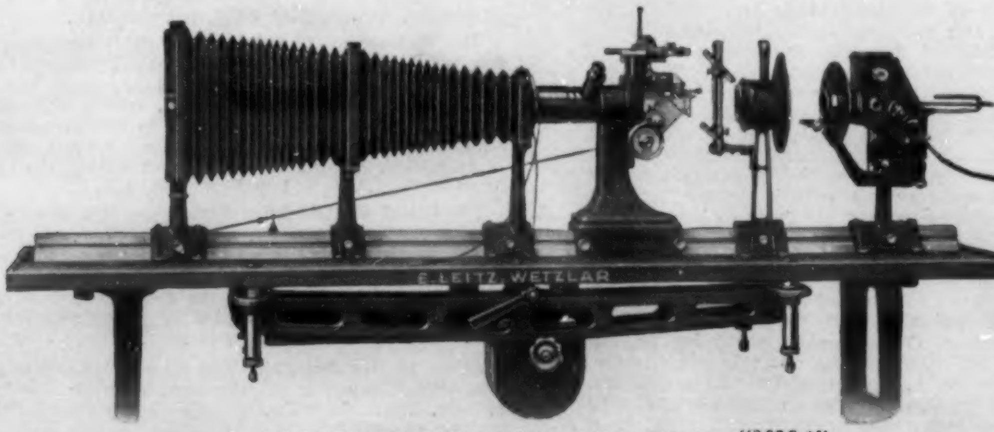
Both Micrograms Cover the Identical Subject

1560 X
HYPO-EUTECTOID COMPOSITION STEEL
(SHOWING LAMELLAR-PEARLITE AND FERRITE)

Both Micrograms are Slightly Reduced to Suit Advertising Space

THE LEITZ WORKS now offer for Micro-Metallograph "MM-1" and "MM-2" a novel darkfield illumination device and a series of objectives, contributing very materially to the efficiency of microscopical diagnosis of metal structures. These new products make possible a much more positive revelation and study of characteristic details which until now could not be observed.

THE POSITIVENESS with which the structure is revealed under Darkfield makes it extremely useful in research work for studying new alloys as well as in rechecking observations made in Brightfield. One of the most striking features of Darkfield observation and photomicrography is the extreme contrast coupled with maximum detail. It is practically impossible to obtain a Darkfield photomicrograph of mediocre contrast and the oblique illumination from all sides reveals to the best advantage all the intimate details of the surface being examined and this in a manner impossible to effect with the same degree of control by means of Brightfield illumination.



LEITZ MICRO-METALLOGRAPH, LARGE MODEL—"MM-1"

Write for Literature: Section 52-B

E. LEITZ, INC., Dept. 478, 60 East 10th St., NEW YORK, N. Y.

BRANCHES

Washington, D. C.	*Chicago, Ill.*	*San Francisco, Cal.*	*Los Angeles, Cal.*
1427 Eye St., N. W.	122 So. Michigan Ave.	SPINDLER & SAUPPE	SPINDLER & SAUPPE
		86 Third Street	811 W. Seventh Street

Structure & X-Ray Analysis (5b)

Effect of a Deformation (Pulverization) on the Super Structure Lines and Space Lattice Constant of an Fe-Al Alloy (Einfluss einer Verformung (Pulverisierung) auf die Überstrukturlinien und die Gitterkonte einer Eisen-Aluminium-Legierung) K. Schäfer. *Die Naturwissenschaften*, Vol. 21, Mar. 10, 1933, page 207. Powder photographs obtained on an Fe-Al alloy pulverized in a mortar revealed the absence of super-structure lines and a relatively considerable increase of the space lattice constant of 0.7%. This is attributed to mechanical deformation due to pulverizing. Both phenomena vanished completely upon annealing at 750°C. in H_2 for 10 hrs. while a transitional stage resulted on heating to 350°C. for 30 hrs. Analogical results were previously obtained by Dehlinger & Graf (*Zeitschrift für Physik*, Vol. 64, page 359, 1930) on Au-Cu crystals in which the tetragonal ratio of the axis c/a was changed due to hammering. EF (5b)

Significance of X-Ray Inferences in Metallurgy (Ueber die Bedeutung der Röntgenstrahlinferenzen für die Metallkunde) E. Schmid. *Mitteilungen der deutschen Materialprüfungsanstalten*, Sonderheft 21, 1933, pages 70-74. See *Metals & Alloys*, Vol. 4, Aug. 1933, page MA 248. Ha (5b)

Transformation and Change in Properties of Gold-Copper Alloy. (Umwandlung und Eigenschaftsänderungen der Legierung Gold-Kupfer.) E. Schuch. *Metallwirtschaft*, Vol. 12, Mar. 17, 1933, pages 145-147. Alloy of composition AuCu in the form of 5 mm. dia. wire was annealed at 600° C., quenched, and drawn at 200° to 350° for various lengths of time. Transformation from cubic to tetragonal lattice, which is accompanied by an increase in hardness, was studied by precision X-ray measurements and hardness and conductivity determinations. Intensities of the diffraction patterns were measured by means of a photometer. The patterns of the intermediate stages are very indistinct, but careful examination discloses that there is a gradual transformation from cubic to tetragonal without any intermediate phase, the intermediate stages consisting of both phases together. Apparently a certain time is necessary to activate a lattice or bring it to the point at which it is capable of transformation. From the X-ray measurements the percentage of cubic phase remaining after drawing is estimated and shown graphically. These curves compare closely with the hardness curves. However the electrical resistance changes much more slowly than the lattice and hardness. When the latter changes are complete the electrical resistance has changed only 60%. 12 references. CEM (5b)

X-Ray Study on the Electrolytic Fe-Ni Alloys. Keizo Iwase & Nobuyaki Nasu. *Bulletin Chemical Society of Japan*, Vol. 7, Sept. 1932, pages 305-314; *Kinzoku no Kenkyu*, Jan. 1933, pages 26-34. (In Japanese.) Fe and Ni were co-deposited in various proportions electrolytically from their mixed sulphate solutions, and X-ray diffraction patterns were photographed by the Debye-Scherrer and Seeman-Bohlin methods; the lattice constants were calculated. Following results were obtained: Fe and Ni in deposit seem to form a solid solution, but their homogeneity is not so good as alloys solidified from melts. The α and γ solid solutions range from 14 to 58% of nickel in the deposit, but only 25 to 33% Ni in the case of the alloys melted thermally. Lattice constant of α (or γ) solid solution increases slightly at first, reaches maximum and then decreases as the content of Ni (or Fe) increases respectively. The X-ray spectral lines of the deposited alloys were found to be too much diffused to ascribe it to the occluded H gas in the alloy made thermally. Thus the authors concluded that Fe and Ni are not deposited as a pure solid solution. KT + Kz (5b)

The Crystal of Zinc Coating the Surface of Iron Sheet. Yoshiaki Matsunaga. *Memoirs College of Science, Kyoto Imperial University*, Nov. 1931, (A) 15, 263-265. Zn coating of galvanized iron sheet has been examined and X-ray and Laué photographs obtained. Zn crystals are so oriented that (0001) plane is inclined to the surface of the sheet at an angle of 18°. HN (5b)

X-Ray Study on the Diffusion of Copper into Nickel. Chujiro Matano. *Memoirs College of Science, Kyoto Imperial University*, Nov. 1932, (A) 15, 351-353. The coefficients of diffusion of Cu into Ni have been determined from the changes of radii of Debye rings, as 3.5×10^{-7} cm^2/day at 650°C. and 1.9×10^{-5} cm^2/day at 890° C. HN (5b)

X-Ray Investigation of the Solubility of Al in Cu (Röntgenographische Untersuchung der Löslichkeit von Aluminium in Kupfer) I. Obinata & G. Wassermann. *Die Naturwissenschaften*, Vol. 21, May 26, 1933, pages 382-385. The aim of this investigation was (1) to find out whether the X-ray method can be successfully applied to the determination of phase boundary lines of systems where the solid solution formation increases with falling temperatures and (2) to check on the α phase boundaries of the Cu-Al system previously established by Stockdale (*Journal Institute of Metals*, Vol. 28, page 273, 1922). Only minor divergencies from the formerly adapted solubility line were found. No change of solubility of Al in Cu in dependence on temperature was found below 650° C. In all investigated Al-Cu solid solutions, no correlation of space lattice constant to grain size or to genesis of the crystals could be noticed. The space lattice constant of Cu increases considerably with rising Al content. The maximum solubility of Al in Cu was 19.7 atomic % or 9.5% by weight. 16 references. EF (5b)

Contributions to Knowledge of Galvanic Voltages and of Constitution of Gold Amalgams (Beiträge zur Kenntnis der galvanischen Spannungen und der Konstitution von Goldamalgamen) R. Kremann & R. Baum. *Sitzungsberichte der Akademie der Wissenschaften in Wein, Mathematisch-Naturwissenschaftliche Klasse*, Abt. II b, Vol. 141, No. 8, July 7, 1932, pages 693-707. Previous work on the Au-Hg constitutional diagram is reviewed. Alloys with 24.6% Au could be submitted to metallographic examination although including a considerable quantity of the liquid phase which decreased with rising Au contents. The samples were entirely solid above a concentration of 46% Au. Squeezing tests indicated the existence of the compounds Au_2Hg_3 and $AuHg_2$. The compounds Hg_9Au and Hg_4Au may exist if Hg is easily squeezed out of the lattice of these compounds by application of low pressures. The e.m.f. gained on both electromotive series are tabulated and graphically presented. The data obtained show that time exerts an influence. Au alloys with 30% Au for instance become baser and baser in contrary to amalgams with 60-70% Au which change to nobler potentials. A practically constant value of 0.30 $\pm$ 0.1 volts was obtained. Au amalgams up to 75% Au display the Hg potential. The compounds Au_3Hg and Au_4Hg as well as the gold-rich alpha solid solution yield a potential approaching that of pure gold. WH (5b)

A Calibration Substance Particularly Suitable for Precision Determinations of Space Lattice Constants According to the Debye-Scherrer-Hull Method (Eine für Präzisionsbestimmungen von Gitterkonstanten nach der Debye-Scherrer Methode besonders geeignete Eichsubstanz) K. Möller. *Die Naturwissenschaften*, Vol. 21, Mar. 17, 1933, pages 223. The writer urges the use of thallous-chloride the space lattice constant of which was found as 3.380 A.U. at 18° C. based on the Ag space lattice constant of 4.078 A.U. at the same temperature. The new calibration compound fulfills the following requirements: (1) it can be secured in a highly pure state, (2) it reflects well and yields very clear interference rings and (3) a great number of interference rings of reasonable intensity are uniformly distributed over the film. EF (5b)

Crystalline Structure of Ferromagnetic Iron Oxide. V. Danilov, G. Kurdumov, E. Ploujnick & T. Steletzkaya. *Domez*, No. 12, 1932, page 67 (In Russian). X-ray investigation of ferric oxide which has been rendered magnetic by heating showed that the ore has the same rhombohedral structure as the untreated. The same heating treatment applied to pure Fe_2O_3 did not convert it into magnetic variety. Impurities present in ore, apparently, have a pronounced effect on magnetic transformation. (5b)

PHYSICAL, MECHANICAL & MAGNETIC TESTING (6)

Produces X-Ray Stereoscopic Images in Three Dimensions. *Steel,* Vol. 91, Dec.
1 26, 1932, page 27. The possibilities of a stereofluoroscope especially designed for the examination of small Al and Fe castings in 3-dimensional relief are considered. JN (6)

On Irregularities in Magnetization. K. J. SIXTUS. *Physical Review,* Vol. 44, July 1933, pages 46-51. Line patterns of FeO deposited from a suspension, similar to those observed by F. Bitter on large crystals of Fe and Ni, have been studied on cold-drawn polycrystalline Ni-Fe wires under uniformly applied stress and in a magnetic field. The patterns consist of parallel lines but they differ from the highly regular patterns published by Bitter, in that spacing between adjacent lines varied considerably and in that they appeared very consistently in the same places even after changes in magnitude and direction of the applied field. The spacing of the lines lay within the range of 0.7 to 10 x 10^{-3} cm. Both experi-
2 ments on a wire under tension and the agreement of results on a twisted wire with conclusions from R. Becker's theory prove that the lines form perpendicular to the direction of induction in the material. No further evidence regarding the origin of the pattern could be found. WAT (6)

Testing of Files. (Die Prüfung der Feilen.) A. SLATTENSCHEK. *Mitteilungen des Technischen Versuchsamtes Wien,* Vol. 21, 1932, pages 98-110. In spite of far-reaching mechanization of shop operations the use of the file is still of greatest importance in machining; the comparatively short life, however, makes it one of the most expensive tools. A thorough investigation is made to determine exact methods for machine-testing of files with consideration of thread, angle, cut of teeth and length of file and the energy used for a definite amount of material re-
3 moved. The area of the section of a chip made with the file is taken as a measure of sharpness, the file will last until this factor has become zero, that is, so dull that no chip can be removed any more. Test curves illustrate the results. 21 references. Ha (6)

Tests on Threaded Sections Show Exact Strengthening Effect of Threads. E. M. SLAUGHTER. *Metal Progress,* Vol. 23, Mar. 1933, pages 18-20. Tensile tests have been made on cap screws in various sizes on S. A. E. 1035, 2330 and 3135 steels. The area was figured on root diameter, pitch diameter, and an average of the two. The relative correctness of the 3 methods may be judged from the table of results where the tensile strength of the machined original bar of each material is also given. Strength computed on the root area of the thread gives a false high value, 5 to 16% too high, on the area of the pitch a false low value, 3 to
4 16% too low. Size of the screw and thread has some effect on the results. Strength computed on mean diameter is slightly small, up to 3.8%, in 17 of 22 averaged values. The other 5 are slightly high. Tests on slightly different diameters of a 9/16ths in. screw show that a bar reduced to the mean diameter will break in the threads. Test pieces whose central portion was still further reduced to a diameter theoretically equal to the threaded ends will break either in the thread or in the center. The strengthening effect of the thread is due to the increased amount of metal in the thread above its root and to the thread form itself. Calculations based on the mean diameter should be used in designing. WLC (6)

Relation between the Elasticity and Tensile Strength of Cast-Iron and its Structure. (Abhängigkeit der Elastizität und Zugfestigkeit des Gusseisens vom Gefüge.)
5 H. SCHLECHTWEG. *Archiv für das Eisenhüttenwesen,* Vol. 6, May 1933, pages 507-510. The elastic properties of cast-iron as modified by changes in structure on annealing were studied. The modulus of elasticity was lowered with increasing graphite content and size of the graphite flakes. The tensile strength was found to be related to a constant ($B + C\sqrt{2/3}$) in the equation of the stress-strain curve, this depended on the grain size of the ferrite matrix. SE (6)

Autographic Stress-Strain Curves of Deep Drawing Sheets. REID L. KENYON & ROBERT S. BURNS. *Transactions American Society for Steel Treating,* Vol. 21, July 1933, pages 577-612. A new wedge extensometer that gives accurate autographic stress-strain curves for sheet tensile specimens is described. Curves are shown that demonstrate advantages of equipment over old methods. Upper and lower
6 yield points can be determined on some specimens, but a 0.5% yield point must be used where no yield point is shown by curve. Lower yield point is thought to be more useful value. A celluloid ruler for measuring yield point elongation and uniform elongation from stress-strain curves is described. A quantitative relationship of stretcher straining between material with a sharp yield point and material without a sharp yield point is shown by tests and illustrated by stress-strain curve graphs. Cumulative effect of cold rolling causes a decrease in radius of curvature at transition from elastic to plastic portion of curve. Breaking load is shown by this equipment. Construction of true stress-strain curves for sheet tensile specimens and their limitations are described. 12 references. WLC (6)

Impact Testing of the Italian States Railroad. (Die Kerbschlagprüfung bei den Italienischen Staatsbahnen.) M. FÜCHSEL. *Organ für die Fortschritte des*
7 *Eisenbahnwesens,* Vol. 87, May 1, 1932, pages 181-182. Digest of an article by Steccanella before the International Association for Testing Materials. See "The Notched-bar Impact Test as an Acceptance Test," *Metals & Alloys,* Vol. 4, May 1933, page MA 144. EF (6)

Tests on Thin Sheet Metal. C. N. FLETCHER. *Mechanical World & Engineering Record,* Vol. 91, June 10, 1932, pages 553-554. Description and application of the Olsen machine designed to measure simultaneously the depth of the cup and the pressure required to produce it. Another sheet-testing machine mentioned is designed by C. E. Williams. It draws automatically a stress-strain diagram showing the relation between depth of cup alongside the pressure applied. Kz (6)

8 **Influence of Illumination in Measuring Brinell-Ball Impressions.** HANS ESSER & HEINZ CORNELIUS. *Metal Stampings,* Vol. 5, July 1932, page 446. Translated from *Stahl und Eisen,* Vol. 52, No. 20, page 495. See *Metals & Alloys,* Vol. 4, Feb. 1933, page MA 36. MS (6)

Influence of Strong Magnetic Fields on Hardening of Metals and Alloys. (Über den Einfluss starker magnetischer Felder auf die Härtung von Metallen und Metall-Legierungen.) HANS ESSER & HEINZ CORNELIUS. *Metallwirtschaft,* Vol. 12, Apr. 14, 1933, pages 210-213. Theoretical aspects of influence of magnetic fields on structure of metals are discussed. On account of disagreement of other investigators with Herbert about effect on hardness of steel, his experiments were duplicated. Carbon steels containing from .40 to 1.50 C were rotated in magnetic
9 fields of 6750 and 9500 gauss and tested with a Herbert pendulum. In most cases no effect on the hardness was noted, in others the effect was irregular, without definite relation to the magnetic treatment, and usually within experimental error. It was then found that the Herbert pendulum is extremely sensitive to temperature variations and that tests must be made in a constant temperature room to obtain consistent results. Further tests under constant temperature using 16000 gauss field strength showed no effect of the magnetic treatment on the Herbert hardness of 1.18 C steel. Rockwell hardness tests on several other C and alloy steels also showed no effect. 10 references. CEM (6)

Mechanically Recording Industrial Extensometer. (Extensomètre Industriel à enregistrement mécanique.) PIERRE CHEVENARD. *Revue de Métallurgie,* Vol.
10 30, Mar. 1933, pages 85-95. Mechanical details of an extensometer composed of 2 unequal arm levers and used with standard tensile test bar are fully described. Shorter arms are fitted into holes made in test bar, longer carry recording pens. Several examples of curves obtainable with the apparatus both during normal tensile testing and determination of creep at elevated temperatures are given. A set up for creep determination comprising proposed extensometer is described. JDG (6)

Static and Dynamic Stress of Steel Structures in the Light of X-Rays (Statische und dynamische Beanspruchung von Stahlkonstruktionen im Lichte der Roentgenstrahlen.) FRITZ REGLER. *Mitteilungen des Technischen Versuchsamtes Wien,* Vol. 31, 1932, pages 31-46. A few X-ray methods for quantitative determination of interior stresses and numerical evaluation of static and dynamic stresses of steel and other metal structures are described and their theoretical principles explained. They are particularly adapted for detecting otherwise hardly measurable stress distributions in bridges, rails, wheel tires, etc. and revealing local overstressing leading to failures. The methods are simple and require only 1 min. exposure for even the finest structures. The practical advantage lies in the fact that the tests can be made on site under service conditions and are non-destructive. 8 references. Ha (6) 1

Wear of Metals with Hard Surface. (Abnutzung von Metallen mit harter Oberfläche.) N. N. SAWIN. *Feinmechanik und Präzision,* Vol. 40, May 1, 1933, pages 69-76. The nature of wear and the relation of other mechanical properties, especially hardness, to wear is briefly discussed. The cause of wear is seen in a rolling or gliding friction (with or without lubrication). A tool steel of least wear can be obtained in cases where a mixed structure of hardenite, martensite, troostite and osmondite exist that has been drawn at 400° C. Apparatus and their principle for measuring wear are reviewed and the wear-testing machine "Skoda-Sawin" for rapid testing of wear of objects with hard surface is described. The groove caused by a rapidly rotating disk of Widia metal (tungsten carbide) in a definite time under definite conditions is used as measure for wear. Tests with different cooling liquids are described. The wear was in all cases proportional to the number of revolutions of the wheel. That the hardness of greatly differing materials is by no means a criterion of wear resistance was again confirmed by these tests. Only when comparing similar materials can hardness be considered as significant for wear resistance. 6 references. Ha (6) 2

A Magnetic Balance for the Inspection of Austenitic Steels. RAYMOND L. SANFORD. *Bureau of Standards Journal of Research,* Vol. 10, Mar. 1933, pages 321-326. Describes an experimental model of a magnetic balance for measuring attractive force between a permanent magnet and a specimen of austenitic steel with which it is in contact. Experiments with this model indicate that such an instrument should be of considerable practical value for the inspection of corrosion-resistant austenitic steel in view of the fact that the magnetic permeability has been found to be a good index of the resistance to corrosion of this type of material. The instrument is portable and can be applied to different parts of a completed structure. WAT (6) 3

F Scale for Brass. ALVAN L. DAVIS. *Metal Progress,* Vol. 23, Apr. 1933, page 48. Medwedeff's article on "Workability of Brass" in Feb. *Metal Progress* should have had Rockwell F instead of B for the hardness table. The F scale applies to the 60 kg. load with 1/16th in. ball which load is stated in the table. The 7 Rockwell scales will be described by the writer in the National Metals Handbook. WLC (6) 4

Elastic Hysteresis in Crankshaft Steels. S. F. DOREY. *Mechanical World & Engineering Record,* Vol. 92, Dec. 16, 1932, pages 584-587. Results of measurement of the energy dissipated when the materials undergo cycle variations of torsional stress are given for crankshaft steels. All steels exhibited a quasi-critical point marking a change in hysteresis properties. The high elastic steels showed low damping capacity. The hysteresis can be almost entirely removed in the case of low-C steels by heating in boiling water for 1 hour. Kz (6) 5

Fatigue of Metals & Alloys (6f)

Influence of Preliminary Stress on Endurance Strength (Einfluss der Vorspannung auf die Dauerfestigkeit) P. LUDWIK & J. KRYSTOF. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, June 17, 1933, pages 629-635. Materials are very often subjected to stresses in which an existing, preliminary static stress is superimposed by an alternating stress; this case is much more frequent than a pure vibrating stress. It was investigated in which manner the relations between preliminary stress, alternating stress and endurance strength can be best represented in order to be able to properly compare results obtained with different materials. 3 different diagrams are discussed. Preference is given the method in which the ratio of alternating to static stress is used as abscissa and the ultimate strength as ordinate. Tests were made on hard and soft ferrous and non-ferrous materials below and above the yield point. The results with notched and corroded samples show an increase of the endurance strength with increasing preliminary stress ratio. 28 references. Ha (6f) 6

Endurance Strength of Valve Spring Wire (Die Wechselfestigkeit des Ventilfederdrahtes) E. LEHR. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, June 17, 1933, pages 648-649. A review of tests made to ascertain the endurance strength of spring wire of various materials under oscillating stresses. It could be concluded that the endurance strength of all steels and in particular of Cr-V steel, can be increased considerably if the surface of the wire is ground. The latter steel showed an increase from 19 to 32 kg./mm.², high C steels from 14 to 26 kg./mm.² As the grinding process is, however, inconvenient for mechanical reasons the author suggests case-hardening the finished springs or making them of nitrided material. Ha (6f) 7

Fundamentals of Fatigue Failures and Methods for Improvement of Resistance to Fatigue. (Gesetzmässigkeiten des Dauerbruches und Wege zur Steigerung der Dauerhaltbarkeit) H. OSCHATZ. *Mitteilungen der Materialprüfungsanstalt an der Technischen Hochschule,* Darmstadt, No. 2, 1933. Published by VDI Verlag, Berlin, 63 pages, 75 figures, 76 references. A practical discussion for the engineer, dealing with types of fatigue fractures, with stress concentration and how to minimize it. Considerable experimental work is recorded on notched endurance bars, but this is confined to three low carbon steels all at hardnesses from 105 to 122 Brinell. The effect of stress concentration in hard steels is not dealt with, and hence the principles described are not brought out in so striking a fashion as they might have been. The subjects discussed have been equally fully dealt with in several other recent publications. HWG (6f) 8

Design of Railway Vehicle Axles from the Viewpoint of Repeated Stresses in their Force-fitted Parts. S. IKEDA. *Journal Society of Mechanical Engineers, Japan,* Vol. 36, Feb. 1933, pages 101-109. Paper read before the Meeting of the Society of Mechanical Engineers of Japan, Oct. 9, 1932. Designing axles, bending and torsional stresses are commonly taken into consideration. The compressive stress in the axle part covered by the wheel center amounts to a fairly large value due to force fit and effects other stresses in this part. Furthermore the axle undergoes shearing stresses. The author has determined the principal stresses resulting from different causes at all points in a cross-section of the force-fitted part. Kz (6f) 9

Fatigue Limit of Welded Joints (Über die Dauerfestigkeit von Schweissverbindungen) OTTO GRAF. *Der Stahlbau,* Vol. 6, May 26, 1933, pages 81-85; June 9, 1933, pages 89-94. In experiments described following points were considered in particular: (1) condition of material in welded area, (2) effect of type of joint made, (3) way in which joint was loaded, (4) effect of initial stresses caused by welding. Results are compared with corresponding rivet joints. GN (6f) 10

The Testing of Wire and Wire Rope. A. V. DEFOREST & L. W. HOPKINS. *Wire & Wire Products,* Vol. 7, Sept. 1932, pages 286-288, 305; Dec. 1932, pages 421-426, 440. See *Metals & Alloys,* Vol. 4, June 1933, page MA 175. Ha (6f)

ELECTRO-CHEMISTRY (7)

Electroplating (7a)

Electrodeposition of Chromium from Tervalent Chromium Salt Solutions. II. Chromium Acetate, Oxalate and Tartrate Baths. H. T. S. Britton & O. B. Westcott. *Metal Industry*, London, Vol. 42, Feb. 3, 1933, pages 155-158. See *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 316. Ha (7a)

Chromium Plated Screw Gages. L. A. B. *Machinery*, London, Vol. 41, Feb. 16, 1933, pages 573-574. Difficulties frequently arise when Cr plating of screw gages is attempted, because the deposit flakes off in places. The author sees the solution to the problem to be a modified form of thread, the characteristics of which would be an increased root radius, a reduced crest radius, a thinner thread, and a considerably reduced effective diameter. Kz (7a)

The Electrodeposition of Nickel and Chromium. J. W. Cuthbertson. *Metallurgia*, Vol. 8, Aug. 1933, pages 109-110. Practical directions for Cr plating. JLG (7a)

Replating Hard Chromium. R. J. Piersol. *Metal Cleaning & Finishing*, Vol. 5, July 1933, pages 279-282; *U. S. Patent* 1,774,901, Sept. 2, 1930. In order to electrodeposit Cr on top of another so that the second deposit adheres firmly to the first deposit, the author allows the article with the first Cr deposit to remain in the plating bath (chromic acid type) for a certain length of time with no external voltage impressed on it but with the plating circuit closed, so that an electric current is generated by the galvanic action between the article itself and the lead anode, which current etches the Cr surface of the article so that when the external voltage is applied, the new Cr deposits as a true continuation of the crystalline structure of the first deposit. A reversed current making the article an anode, when properly applied, accomplishes the same result. LCP (7a)

New Anodes for Cr Plating Solutions. (Neue Anoden für Verchromungsbäder.) H. Rüttermann. *Metallwaren Industrie und Galvano Technik*, Vol. 30, July 15, 1932, pages 318-319. Points out the danger of poisoning when removing the $PbCrO_4$ coating on Pb anodes and recommendation of the "Ibo Aktiv" anodes of the Stamm & Hoppe Co., Solingen. (See also following abstract.) EF (7a)

New Anodes for Cr Baths. (Neue Anoden für Chrombäder.) G. Elssner. *Metallwaren Industrie und Galvano Technik*, Vol. 30, Aug. 15, 1932, pages 355-358. Literature shows Pb and hard lead are suitable anode materials for Cr plating while Cr, Fe, steels and other anodes contaminate the bath. Reports on results gained on the "Ibo Aktiv" anodes (see abstract above) which consist of superficially Cr-plated Fe (0.027 g. Cr/dm.^{2}). The Cr deposit is dissolved after 30 sec. and the remaining Fe anode goes into solution uniformly at a rate of 0.023 g. Fe/amp. hr. EF (7a)

Experiments on the Galvanic Precipitation of Chromium Alloys from Chromic Acid-free Electrolytes. H. Cassel. *Metal Industry*, London, Vol. 42, June 23, 1933, page 646. Experiments to deposit pure Cr from chromic acid-free electrolytes on Cu or brass cathodes showed always a decrease in the current efficiency from the initial 25% to about 8% after 5 min. and 3% after 10 min. of electrolysis; beyond this time no increase in the thickness of the cathode layer could be produced by any change in the bath. The results seem to indicate that more satisfactory conditions for the deposition of Cr may only be obtained by changing the anions of the Cr electrolyte. It is expected that those anions which penetrate most effectively the passivity layer will also create most favorable conditions for the discharge of the ions. Ha (7a)

Chromium Plating on Zinc. M. deKay Thompson & F. C. Jelen. *Transactions Electrochemical Society*, Vol. 63, May 1933, pages 141-148. A comparison of various undercoatings prior to chromium plating on 85% Zn was made using an immersion test in 20% NaCl, in 5% NH_4Cl, and in 10% $(NH_4)_2SO_4$ as a criterion of the merits of the several combinations, i.e., Ni flash-Cu-Ni-Cr, with Ni plated from a bath containing sodium citrate, is best; Ni-Cr, with Ni not less than 0.0003 inch thick, comes next; Ni flash-Cu-Cr next; Cr directly on Zn gives least protection; Sn-Cr or Cd-Cr gave no protection to Zn at all. LCP (7a)

Chromium Plating Literature. XII, XIII, XV, XVI. L. H. Decke. *Platers' Guide*, Vol. 29, Apr. 1933, pages 13-14; May 1933, pages 9-10; July 1933, pages 17, 20-21; Aug. 1933, pages 12-14. These installments deal with buffing, polishing, cleaning, corrosion and porosity. WHB (7a)

Gravimetric Determination of Sulphuric Acid in Chromium Bath. (Die gewichtsanalytische Bestimmung im Chrombad.) K. W. Froehlich. *Angewandte Chemie*, Vol. 45, July 30, 1932, pages 508-510. Method is described in detail. A small sample (5-10 cc. of the chromium bath) is required to which concentrated HCl, alcohol, glacial acetic acid and Na acetate are added. The sulphate is precipitated. Ha (7a)

Deposition of Copper and Silver from Solutions of Their Iodides. (Über die Abscheidung von Kupfer und Silber aus den Lösungen ihrer Jodide.) M. Schlötter, Joachim Kurpiun & Werner Burmeister. *Zeitschrift für Metallkunde*, Vol. 25, May 1933, pages 107-111. A study of the electrodeposition of Cu and Ag from aqueous solutions of their iodides containing alkali and alkaline earth iodides and bromides. In order to obtain coherent and uniform deposits it is necessary to employ acids which dissociate strongly and do not undergo compound formation in the electrolyte (solutions of the hydrogen halide acids were employed), and to use colloids like gelatin or glue. Various satisfactory electrolyte compositions are quoted, and special details of procedure are described. The deposits in many cases differ in appearance and in mechanical and physical properties from those of the pure metals. This difference is ascribed to absorption of I. The state of existence of this iodine was studied microscopically and by the determination of lattice unit cell size by X-rays, with the conclusion that a portion of the I (or iodide) is in solid solution with the base metal and the remainder mechanically admixed; the lattices of both Cu and Ag are expanded by this absorption. No iodine is formed in Cu deposited at current densities below 0.15 amp./dm.^{2}, but above the amount increases rapidly, resulting in a hard and brittle deposit. Ag absorbs much less I, but absorbs appreciable quantities at current densities of 10 amp./dm.^{2} when the temperature is kept at 5° C.; the deposit is gold in color. RFM (7a)

Investigations of Denickeling Baths. (Untersuchungen über Entnickelungsbäder.) H. Krause. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle*, Vol. 5, Jan./Feb. 1932, pages 104-107; Mar. 1932, pages 121-126; Vol. 6, July 1932, pages 32-35. See *Metals & Alloys*, Vol. 4, July 1933, page MA 215. Ha (7a)

Tensions of Electrodeposits of Metals. (Sur les Tensions des Dépots Electrolytic des Métaux.) C. Marie & N. Thon. *Journal de Chimie Physique*, Vol. 29, Jan. 25, 1932, pages 11-17. See *Metals & Alloys*, Vol. 4, Sept. 1933, page MA 287. MAB (7a)

Clear and Color Finishes on Aluminum. The Alumilite Process. Ralph E. Pettit. *Industrial Finishing*, Vol. 8, Feb. 1932, pages 12-14. The Alumilite process produces a non-conducting oxide film on Al and Al alloys by employing these metals as anodes in an electrolysis bath. The films produced have a breakdown potential of 500 volts and possess high resistance to both corrosion and abrasion. They may be colored by a variety of organic and mineral dyes. A large number of uses has been found for these coated metals. JN (7a)

Electrometallurgy (7b)

Prevention of Injurious Effect of Antimony in Electrodeposition of Zinc and Copper. Naoto Kameyama & Hiroshi Iida. *Journal Society of Chemical Industry*, Vol. 36, Supplemental binding No. 4, Apr. 1933, pages 173-174. An abstract. The addition of potassium acid tartrate to sulphate solutions of Cu and of Zn, respectively, in proportions up to 20 times the Sb equivalent showed distinctly favorable results in the case of Cu and negligible ones with Zn. WHB (7a)

Electrolytic Deposition of Metallic Niobium and Its Separation from Tantalum. (Ueber die elektrolytische Abscheidung von metallischem Niob und seine Trennung von Tantal.) N. Isgarischew & A. F. Prede. *Zeitschrift für Elektrochemie*, Vol. 39, May 1933, pages 283-288. The electrochemical preparation of metallic Nb and Ta and their separation is best carried out either with KOH as solvent or with citric or oxalic acid. In both cases Nb_2O_5 and Ta_2O_5 were obtained from the ore. Cu proved to be the best cathode material to deposit Nb. Ta remains in the solution and could be precipitated after the electrolysis as Ta_2O_5. The alkaline process can be utilized for Nb plating. Nb deposits are corrosion-resisting also against mineral acids. The acid process is suitable for electro-analysis of mixtures of both metals. Ha (7b)

Antimony Extraction by Electrolysis. C. C. Downie. *Electrical Review*, Vol. 112, Apr. 7, 1933, page 483. For recovery of Sb from metal wastes, the residues are ground and mixed with their own weight of coal and 3 times their weight of salt-cake. The mixture is smelted in a reverberatory furnace, converting the metals to sulphide. Sb, being in the soluble condition, is dissolved out. Electrolysis is conducted in an Fe tank or series of tanks. Cathodes are made from sheet Fe while in some systems sides of tank also serve as cathodes. Anodes consist of cast Pb plates, usually made from scrap Pb. No definite regulations of alkali concentration, temperature, c.d. etc. can be given due to the variable composition of the liquor from the smelting process. It is desirable that the Sb be present as the sulphantimonite, which insures a considerable saving in current. Deposit is in the form of powder or shining scales depending on c.d. employed. Great resistance difficulties are encountered in this work. Deposit is mixed with a small proportion of flux, compressed into blocks, and melted in a kettle under grease or tallow. MS (7b)

Installations for Electrolytic Refining of Metals. (Installations pour le raffinage électrolytique des métaux). *Journal du Four Electrique*, Vol. 42, June 1933, page 210. Very general description of electrolytic refining methods. JDG (7b)

Production of Copper Sheets. *Electrical Review*, Vol. 111, Nov. 18, 1932, page 738. Sherard Cowper-Coles has evolved a process which enables sheets of pure Cu of varying degrees of hardness and of any thickness to be produced in one operation direct from partially refined ingot. It involves electrolytic refining and deposition on a revolving drum. It is claimed that sheets equal or superior to those obtained by rolling are produced. Very thin sheets can be made as cheaply as thick sheets, and of almost any size. Scrap amounts to about 1%. The Cu can be made so hard, without any after treatment, that it can replace P-bronze for spring contacts. Cu sheets have a high mirror finish on one side. MS (7b)

Production of Electrolytic Copper Sheets. A. Eyles. *Metal Industry*, N. Y., Vol. 31, Feb. 1933, page 53. A description of the production of thin copper sheets by Sherard Cowper Coles of England. PRK (7b)

Electrolytic Production of Metallic Lanthanum. (Elektrolytische Herstellung von metallischen Lantham.) *Die Metallbörse*, Vol. 22, June 8, 1932, page 723. Note on the method of Trombe for electrodeposition of La free from Fe (0.006%) and Si (0.05%). Electrolyte: 60 lanthanous chloride, 35 KCl and 5 CaF_2, temperature: 960-980° C, anode: carbon; cathode: Mo; current density 4 amps/cm.^{2}, 7 volts, yield: 65%. M.p. of metal: 885 ± 5° C., Brinell hardness: 36, density: 6.139. EF (7b)

A New Process of Electrolysis which Produces Rare Metals in Pure State. *Metal Industry*, N. Y., Vol. 31, Feb. 1933, page 63. Powdered Th is deposited on the cathode inserted in a fused bath containing NaCl and KCl and some KF. Process can be made continuous. U and Ta can also be similarly deposited. The powder is pressed into bars in an O free atmosphere and then melted in a vacuum induction furnace. The uses of these metals are limited. PRK (7b)

Aluminum Production. *Electrician*, Vol. 111, July 7, 1933, pages 5-6. History of Al production in Great Britain is outlined. Electrode production methods are discussed. Coke made from the coking of pitch is a promising raw material. Design, construction, and operation of the Al cells are given in detail. CBJ (7b)

Preparation of Metallic Neodymium Free from Fe and Si. (Préparation du néodyme métallique exempt de fer et de silisium.) Félix Trombe. *Comptes Rendus*, Vol. 196, Mar. 6, 1933, pages 704-706. Metal is prepared by electrolysis of mixed anhydrous chlorides of Nd and K together with CaFe, fused at 1040°-1060° C. Specific gravity of metal regarded as pure is 6.94. OWE (7b)

Electrodeposition of Noble Metals. (Die elektrolystische Edelmetallabscheidung.) Fr. Vogel. *Russisch-Deutsche Nachrichten aus Wissenschaft und Technik*, No. 11/12, 1932, pages 21-28. Discussing critically the methods used for separating Au and Ag, the author arrives at the conclusion that it is advisable to remelt low AuAg alloys into a high Ag alloy by adding the latter metal. The electrolytic Ag refining according to Siemens & Halske corresponds more to practical demands than the method of Dietzel. EF (7b)

Beryllium Alloys have Commercial Possibilities. Alfred Stock. *Iron Age*, Vol. 129, June 23, 1932, pages 1346-1383. Abstract of paper read before the Electrochemical Society. See "Beryllium," *Metals & Alloys*, Vol. 4, Mar. 1933, page MA 67. VSP (7b)

Electrolysis of a 10/90 Be-Cu Alloy in Molten State. (Über die Schmelzflusselektrolyse einer Beryllium-Kupfer-Legierung mit 10% Beryllium.) L. Lämmermayr. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse*, Abt. II b, Vol. 141, Oct. 20, 1932, pages 829-832. A melt consisting of 10.29% Be, 87.66% Cu and 1.23% Fe was submitted to electrolysis at 6 amp./mm.^{2} for 4 hrs. at 1050° C. Cu was found to travel to the anode while Be migrated to the cathode showing that Be must be placed near Al or Ag and to the right of Cu in the electromotive series previously determined on molten alloys: anode ← He, Ne, Ar, Bi, Sb, Hg, Pb, Sn, Zn, Cd, Cu, Ag, Al, Na, K → cathode. Due to the high testing temperature a dissolution of Fe from the electrodes takes place which is also encountered during the electrolysis of Al. Owing to this the theoretical electrolysis output of 6.6% is reduced. Metallographic proof for the findings is furnished. WH (7b)

Electrolytic Refining of Copper Using Complex Salt of Cuprous Chloride. X. Behavior of Antimony (continued). Naoto Kameyama & Shoji Makishima. *Journal Society of Chemical Industry*, Japan, Vol. 35, Aug. 1932, pages 369B-371B. Authors made controlled tests as to the efficiency of tartrates in the production of antimony-free Cu electrolytically, and included: (a) presence of Sb only in the electrolyte, tartrate being added or not added; (b) Sb present only in the anode; (c) both electrolyte and anode contained Sb (in *b* and *c* tartrate was added) (d) this process of refining is fairly successful as to the separation of Sb in every respect, that is, in prevention of the cathodic contamination, current efficiency, cell voltage, etc. The physical properties of cathodic deposits are generally very good and exhibit no indication of being injured by the influence of Sb. MAB (7b)

METALLIC COATINGS OTHER THAN ELECTROPLATING (8)

Metal Coatings for Steel. MARVIN J. UDY. *Mining & Metallurgy*, Vol. 13, Apr. 1932, pages 173-174. Metallic coatings are used to improve its appearance, to resist corrosion and to resist wear and abrasion. Coating for improvement of appearance is confined to electroplating. Where resistance to corrosion is primary object Zn, Sn and Cd are applied directly to steel. Cr due to its low coefficient of friction offers considerable resistance to wear. Perfect coatings should be free from pin holes, be of even thickness and adhere well. Of the 3 factors contributing to adherence, cleaning is the most vital. VSP (8)

New Developments in Galvanizing. W. H. SPOWERS, JR. *Iron Age*, Vol. 131, Feb. 16, 1933, pages 270-273, adv. sec. page 12. Discusses 5 major developments which have influenced the quality and cost of galvanized products the past year. They are the perfection of a neutral flux to reduce dross formation, the preparation of a special flux known as No. 20, and a continuous process for galvanizing wire. Application of diffusion flame for heating galvanizing kettles is described. Other developments under way are the perfection of an automatic wipe for galvanized wire, a more permanent container for Zn and bright coat for galvanized products. VSP (8)

Resistance to Heat of Steel Coated with Aluminum. (Über die Hitzbeständigkeit von alumetiertem Stahl.) KONRAD STAUFFER. *Metallwirtschaft*, Vol. 12, Feb. 10, 1933, pages 73-76. Sheet steel test pieces of .08 to .29 C content were coated with 140 to 380 g./m.^{2} of Al by the Schoop spraying process. They were then covered with sodium silicate to exclude air while they were heated to annealing temperature for 40 to 100 min. to diffuse the Al into the Fe. The difference in weight of the plates before and after spraying was taken as the weight of Al applied. The heat resistance of the samples was determined by heating them in an electrically heated tube furnace in an atmosphere of O_2. The O_2 absorption and tendency to crack on bending were measured. Best protection of the steel and physical properties of the coating were obtained by an Al coating of 270 to 350 g./m.^{2} With the higher C steels the coating was more brittle than with the lower C and the lower C steels withstand oxidation better. The protection afforded by these Al coatings is very satisfactory up to 1100°C. If the oxidation temperature is not over 900° the temperature and time of the preliminary diffusion treatment are not important as further diffusion takes place. If a heavy coating has been applied it is better to diffuse at higher temperatures, about 1200°, in order to obtain deeper diffusion. This produces greater uniformity in thickness of coating and reduces the brittleness. CEM (8)

Finishes for Aluminum. T. D. STAY. *Metal Progress*, Vol. 23, Jan. 1933, pages 24-27. A number of finishes for Al architectural ornaments and the methods used to obtain them are described. Al cannot be used for this work as cast due to discoloration and surface blemishes. To remedy this, sand blasting, polishing, buffing, brushing, hammering and other methods are used. Coarse, medium, and fine sand blasting are used depending on the following operations and finish desired. A dark slate-gray color obtained by de-plating electrolytically is used for spandrels. Polishing gives a silver luster with high reflectivity of light. Buffing is used for interior work. Wire brushing gives a high luster finish, but not as high as polishing does. Fine wire brushing and polishing gives a satin finish. Oxidized high light finish, cast hammered, and combination finishes to give contrast are also used. Painting, lacquering, and the alumilite process, which gives an oxide film which is then colored with certain dyes and pigments, are used mostly in interior work. WLC (8)

Embrittlement of Hot Galvanized Structural Steel. S. EPSTEIN. *Mechanical World & Engineering Record*, Vol. 92, Nov. 18, 1932, page 478. See *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 317. Kz (8)

On the Intermetallic Diffusion of Metallurgical Materials. (Sur la Diffusion Inter-Solide des Produits Metallurgiques.) J. LAISSUS. *Chimie et Industrie*, Vol. 29, Mar. 1933, pages 515-526. Physico-chemical phenomena known as cementation may be applied not only to intersolid diffusion of C in metals but also to diffusion of a large number of metallic elements in other metals and alloys. Author presents general principles of subject and gives a brief historical review. Then he gives the results obtained from his personal experimental studies. Subject matter is particularly applied to protection of metals from corrosion. Influence of temperature and time are discussed in general—the latter including penetration by a chemical reaction which gives rise to a definite intermediary compound and penetration by one metal through another. Cementation at low temperature, at average temperature, and at high temperature was investigated on Cr, W, Mo, Ta and B, on V and Co, on U, Ti and Zn, in mild steel and in electrolytic iron. Author made a study of resistance of iron and steel thus treated to oxidation at high temperatures and to corrosion by H_2O, HCl, H_2SO_4 and HNO_3. Results showed that by a judicious choice of special element constituting cementation and by careful operation, a mild steel will have following properties: (1) with Zr and U, a durability comparable to a high grade steel; (2) with Zr and Cr, resistance to oxidation at high temperatures; (3) with Cr, Ta, Mo and W, resistance to corrosion by acid. The cementation of Cu and its alloys was also investigated. Al produced a zone of Al-bronze. With proper heat treatment this metal will compare favorably with mild steel. The absence of equilibrium diagrams makes this study difficult, but tests were made at low temperatures (up to 500°) on Cu with Cd, Zn, and Cr, and at average temperatures on Cu with W, Mo, and Ta. No results are given of these latter tests or of those on other metals which are in the process of experimentation. MAB (8)

INDUSTRIAL USES & APPLICATIONS (9)

Aluminum Powder and Bronze Pigments in the Paint Industry. (La poudre d'aluminium et les bronzes couleurs dans l'industrie des couleurs.) H. RABATÉ. *Revue de l'Aluminum et de ses applications*, Vol. 9, July-Aug. 1932, pages 1789-1820. Extensive survey of the preparation and use of Al powder and bronze pigments. AH (9)

Useful Instrument Alloy. W. F. RANDALL. *Electrical Review*, Vol. 112, Jan. 13, 1933, page 42. Outlines magnetic properties of "Mumetal" and describes its application in instrument transformers, audio-frequency intervalve transformers of radio receiving sets, moving-iron electrical measuring instruments, and shields for electrical instruments and electrical recording and sound-reproducing apparatus. MS (9)

Use of Friction Alloys with a Lead Base and Great Content of Copper. (Conditions d'Emploi des Alliages à Frottement à Base de Plomb et à Forte Teneur en Cuivre.) A. RICHARD & H. ACKERMANN. *Cuivre et Laiton*, Vol. 5, Nov. 30, 1932, pages 523-528. Factors determining satisfactory operation of bearings are discussed; of practical importance is: 1. admission of proper quantity of lubricant at proper place in order to form necessary oil film on shaft, 2. linear and uniform distribution of lubricant on surface of shaft and quality of lubricant; but particularly 3. character of material forming bearing surface. Friction must not develop surface stresses or deformations, and method of machining and polishing surfaces is of great influence. This is illustrated by micrographs of different compositions and methods of polishing. High lead content gives a very good antifriction metal. Ha (9)

Eye Appeal Helps Metal Partitions. GEORGE RICE. *Metal Progress*, Vol. 23, Apr. 1933, pages 49-50. The writer suggests that sheet metal partitions, so much in use in Cal., be factory decorated to increase the market for this material. The usual drab finishes are without appeal, but simple designs and finishes, such as geometrical figures and bronzing liquid, would definitely increase their appeal. He points out that auto body makers do not depend on buyer to decorate car. WLC (9)

Progress in Passenger Car Construction for the German State Railroad. (Fortschritte im Personenwagenbau der Reichsbahn.) C. CARLOWITZ. *Die Eisenbahnwerkstätte*, Vol. 41, June 5, 1933, pages 93-94. Replacement of wooden constructions by steel, profiles, sheet sizes, etc., employed, standardization of 3 car types, adoption of welding and utilization of light metals. The weight of a standard express Pullman car could be reduced from 47,000 to 33,900 kg. due to the advances discussed. WH (9)

The Manufacture of Bolts and Nuts. J. B. NEALEY. *Wire & Wire Products*, Vol. 7, Dec. 1932, pages 418-420, 436-437. Processes employed in production of bolts and nuts, their heat treatment and testing are described. Ha (9)

Recent Developments in the Preparation and Uses of Thallium. JAMES C. MUNCH. *Foote Prints*, Vol. 6, June 1933, pages 1-21. Paper itself is critical review of 103 references, of which 67 were published since 1922. Uncombined Tl does not occur in nature, nor have commercial ores been discovered. Richest ores are lorandite and urbaite (Macedonia), hutchinsonite (Switzerland), crooksite (Sweden). Chief commercial sources are Cu and Fe pyrites and flue dusts from H_2SO_4 plants burning thalliferrous pyrites. Flue dusts usually contain $<$0.5% Tl. Processes of extraction and purification briefly described include Enck's (1929) and Hughes' and Teats' (1932); recent electrolytic deposition processes likewise reported but results of latest investigations aiming at improving present methods of commercial manufacture "have not been made available to the public up to this time." Medical, fungicidal, insecticidal and rodenticidal uses set forth in detail; industrial uses described are photography, photoelectric cells, Cu electrodeposition, fuse metal, bearing metal, thermometric materials, HCl-resistant alloys, "stainless silverware," colored glass, imitation gems, spectroscopic standards, titration standards, catalysts, gravimetric medium, pigments, "non-knocking" motor fuels, etc. If statements in literature are true, "one may anticipate the development of 'stainless silverware.'" MFB (9)

Chrome-molybdenum Steel as Thin-walled Tube Material for Airplanes. MURAJI KINUKAWA. *Tetsu-to-Hagane*, Vol. 18, June 1932, pages 563-577. (In Japanese.) From dynamical and statical tension tests, it is concluded that manufacturing of a thin-walled Cr-Mo steel tube (0.3% C, 1% Cr. 0.2% Mo, $<$0.5% Si, $<$0.7% Mn, $<$0.04% P, $<$0.045% S, $<$0.2% Cu) at room temperature is not difficult. By proper mechanical or heat treatment, tensile strength from 55-150 kg./mm.^{2} and elastic limit from 30-130 kg./mm.^{2} can be obtained. Oxyacetylene welds show good properties if properly made and the same metal as welding rod is used. The corrosion tests of Cr-Mo steel, after various heat treatments with acids, NaCl solution, 5% NaCl + 1% H_2O_2, etc., show good results. ST (9)

Castings Star As Movie Props. J. T. JACKMAN. *Foundry*, Vol. 60, Oct. 1932, pages 12-14, 46. Studio foundryman reproduces a wide variety of objects in non-ferrous metals such as: ornamental castings, guns, knives, railroad trains, etc. Ferrous castings are made in outside foundries. VSP (9)

Welding the Modern Transport Plane. BOB JOHNSON. *Industry & Welding*, Vol. 5, May, 1933, pages 2-4. Materials used and methods employed in the "three-mile-a-minute" plane of the United Air Lines are described in detail. Ha (9)

All Metal Planes for Coast to Coast Transport. R. E. JOHNSON. *Metal Progress*, Vol. 24, July 1933, pages 41-43. The construction of the new all-metal Boeing transport planes for the United Air Lines is described. Body and wing surfaces are covered with duralumin sheet, anodically treated. Spars and ribs are duralumin in the wing and fuselage. Cr-Mo tubing is used in the wing part housing the engine and fuel tanks. The tanks are of pure Al. The tensile strength of the duralumin is raised by heat treatment after aging to 55,000 lbs./in.^{2}. The Cr-Mo tubing has a tensile of 180,000 lbs. Ni steel used for terminals, bolts, and trunions is heat treated as high as 200,000 lbs./in.^{2}. All main parts are easily interchangeable, being bolted instead of riveted, with other planes of the group. Hand work is reduced to a minimum with lower cost of production. WLC (9)

Arc-Welded Construction on German Fire Tower. E. L. KUCHEL. *Industry & Welding*, Vol. 5, May 1933, pages 6-10. Describes the building of a 128 ft. fire escape, made of 5 parts telescoping into one another; the sections are of steel tubing 1-2 mm. thick. It was tested under an angle of 75° by a weight of 770 lbs. suspended at its top; under this condition the bend was only 1/3 of that of a wooden escape. The saving in weight was 26%, and in cost 25% against a wooden escape. Ha (9)

Aluminum Alloys in Vehicle Construction. (Aluminium-Legierungen im Karosseriebau.) M. W. KÜSTER. *Deutsche Motorzeitschrift*, Vol. 10, May 1933, pages 88-94. 10 reasons demanding the use of light metal; the eleventh states that light metal profiles suitable for vehicle construction are more readily obtainable and cheaper mainly due to more favorable working conditions. The occurring stresses and structural details are taken up at length. Information on heat treatment of light alloys is furnished. Elastic deformation ability of light alloys is about 3 times that of structural steel under comparable conditions. Corrosion properties (Anticorrodal) and significance of application in Switzerland are emphasized. On a 30 passenger bus, 800 kg. weight were saved by employing 400 kg. light metal. Average saving in weight amounts to 15%. Patented body frame trimming illustrated permits a further saving in weight of 10-15%. EF (9)

Modern Lubrication Technique. (Neuzeitliche Schmiertechnik.) E. KUHN. *Die Wärme*, Vol. 56, Apr. 15, 1933, pages 234-236. Besides a discussion on problems involved in lubrication technique, testing of lubricants, practical experiences, etc., attention is directed to the advances of bearings and bearing metals. Since the revolution speeds were raised from 200-400 to 1000-2000 r.p.m. (Diesel engines) the original white metals are abandoned in favor of Pb base bronzes (up to 25% Pb) to which small quantities of graphite are added. The alloy is put into place by a special press casting process. These alloys are used for both crank shaft and connecting rod bearings. Tests on Mn containing bearing metals disclosed a reduction of the harmful SnO_2. The crystal structure exerts an influence upon the formation of the lubrication film. Pb bronzes exhibit small Pb islands onto which oil adheres while it prefers the grain boundaries in cast bronzes. The structure of the journal should also be taken into account. Nitrided steels yielded good service as well as a martensite structure. EF (9)

Pure Nickel for Chemical Industry. (Rein- Nickel für die chemische Industrie.) *Apparatebau*, Vol. 45, May 12, 1933, pages 49-52. Containers of pure Ni are used for storing such materials as alkalies in molten and dissolved state, KOH, NaCl, saltpeter, sodium sulphate, ammoniac, tannic acid, carbolic acid, etc. A detailed table shows corrosion stability of pure Ni under effect of various chemical reagents. GN (9)

Manufacture of Locomotive Crankshafts. (Note sur la fabrication des essieux coudés de locomotives.) J. OUDET. *Science et Industrie*, Vol. 16, Sept. 1932, pages 357-360. In a high speed locomotive, the forged crankshaft is the most expensive part of the mechanism; after a certain time this part must be replaced before it is worn out due to the formation of cracks. From practical experience of several railway companies it appears that a self-balanced crankshaft built up of 9 components has a much longer life than that of the forged axle. Method for machining this axle is described in the present article. Special alloy steel had been resorted to in order to prevent the rapid occurrence of cracks. Steel containing Ni 2% and Cr 0.5% has been used in shafts of 31 locomotives of the "Chemins de fer d'Alsace et de Lorraine." Results to date show a substantial improvement as compared with those previously recorded on common C steel shafts. However this alloy steel when heated at 400°-500° C. tends to show the "blue brittleness" although this may be almost completely prevented by Mo additions which, unfortunately, increase the price of the steel. In describing the process of manufacturing of the composite shafts author refers to the use of Ni-Cr steel. FR (9)

The Cracking of White Metal in Diesel Engine Big Ends. H. R. Ricardo. *Mechanical World & Engineering Record,* Vol. 93, Mar. 24, 1933, pages 283-286. About 60% of the manufacturers of oil engines suffer from big-end bearing trouble in the form of cracking of the white-metal linings. If design and cost permit the use of a hardened crankshaft, it becomes possible to employ harder bearing linings, such as lead bronze, gunmetal, or duralumin, depending upon the difference in surface hardness between the crank and the bearing material. Where white metal is used it is best to employ very thin linings of the order of 10-20 thousandths of an inch carried in separate thin steel shells. A connecting-rod made from an Al-alloy with high elastic limit and low modulus will help to eliminate trouble. Kz (9)

Use of Steel Castings in Welded Construction. J. G. Ritter. *Welding News,* Vol. 3, July-Sept. 1932, pages 38-39. Economy attainable by combining cast steel with welded construction and factors affecting it are briefly discussed. Ha (9)

Steel Castings in the Navy. George H. Rock. *Foundry,* Vol. 60, Sept. 1932, pages 28-29, 67. Abstracted from a paper on "Notes on the development of certain materials used in ships of the U. S. Navy," read before Society of Naval Architects & Marine Engineers in New York. Defects usually found in many hull castings are shrinkage cracks, blowholes and cavities. Solution lies to some extent, in improved foundry practice, methods of molding, chilling, size and location of gates, etc. There also must be close coöperation between designer, patternmaker and foundryman. VSP (9)

Selecting Alloy Steels for Locomotive Frames. W. A. Newman & C. F. Pascoe. *Iron Age,* Vol. 129, Jan. 14, 1932, pages 172-175. Investigation of 10 different alloy steel heats made to meet demand for stronger steels in locomotive frames. After casting the frames were given a double heat treatment which consisted of heating to 1800° F. for 2 hr./in. of cross-section, and then to 1450° F. for 1½ hr./in. of cross-section, both being cooled in air. Results were that test bars showed signs of secondary piping at about center of cross-section. Tabulates results of tension and impact tests. VSP (9)

Unique Forming and Welding Operations. F. L. Prentiss. *Iron Age,* Vol. 131, Feb. 2, 1933, pages 198-201, adv. sec. page 20. Describes new methods of manufacturing rear axle housing for automobiles developed by the Midland Steel Products Co., Cleveland. The housings are made from welded steel tubing formed by a new continuous automatic tube-making process. A method of expanding one end of tubing has been devised which is of importance in making the housing from tubular stock. In the second method of making housings, they are made from 2 flat blanks which after forming are welded with a single longitudinal seam. This method is claimed to be more economical. VSP (9)

Monel Metal for Corrosion-Resisting Springs. Warren F. Manthei. *Machinery,* Vol. 39, Sept. 1932, page 24. Very brief note on advantages of Monel metal for springs. RHP (9)

Metal Aids the Sportsman and Camper. J. G. Mapes. *Metal Progress,* Vol. 24, Aug. 1933, pages 15-18. Describes various articles of camping and fishing equipment made of metals. WLC (9)

Steel Partitions. Present and Future Possibilities. John G. Mapes. *Metal Progress,* Vol. 23, June 1933, pages 20-22. 20 to 16 gage, full finished, furniture grade sheet steel partitions are being made by the Mills Co. of Cleveland. The sheet steel is stretcher-leveled, mortise and tenon connecting edges formed by special rolls, and the sheets crimped into a tight fit. Interchangeable friction clips give additional rigidity. Sketches show some standardized connections and joints. Shop assembly expedites installation on the job. Imitation marble, wood, and plaster finishes, as well as paint are used. Waviness of sheets prevents the use of gloss coatings. A 2 in. air space in the panels is filled with insulating material. Soundproofing requires felt runners along the floor and ceiling joints. Reluctance to try something new is blamed for the small use so far of metal partitions, some 10,000 tons a year. Price is the same as plaster walls, maintainance and removal costs lower, salvage value much higher. Movable partitions in homes are predicted for the future. WLC (9)

Advantages of Use of Copper and Brass in Metallic Fittings. (Avantages de l'Emploi du Cuivre et du Laiton dans les Armatures metálliques.) J. Meyral. *Cuivre et Laiton,* Vol. 6, May 15, 1933, page 215. The great advantages in using Cu and brass fittings instead of Fe are pointed out, particularly where rust can damage valuable parts in buildings, as under paintings, murals, etc.; even the so-called rustless steels should not be used in such cases. Ha (9)

"Ferrane." L. E. Miller. *Tsvetnuie Metal'ui,* No. 3, Mar. 1932, pages 360-369. Describes experiments made with object of improving process of manufacture and properties of "Ferrane" (Al-Fe bi-metal) sheet and strip. BND (9)

Reduction in Weight of Mine Cages. (Allègement des cages d'extraction.) L. Lahoussay. *Revue du Nickel,* Vol. 4, Apr. 1933, pages 64-70. A study of the replacement of plain C steel by alloy steels or light alloys for mine cages and of the corresponding economy. A reduction in weight of 30% to 50% can be brought about by such replacement. For existing conditions any replacement is not justified for a working depth smaller than 1500 feet. AH (9)

Alpax for Doors of Railway Carriages. (Les portes en Alpax dans le matériel de chemins de fer.) M. Leroy. *Revue de l'Aluminium et de ses applications,* Vol. 9, Nov.-Dec. 1932, pages 1893-1899. Doors made of alpax for railway carriages are light, solid, economical and are easy to assemble. AH (9)

Adaptation of Dental Amalgams. Raymond P. LeRoy. *Journal American Dental Association,* Vol. 20, July 1933, pages 1218-1223. The adaptation of amalgam fillings to cavities in recently extracted teeth and in steel dies was studied by means of staining solutions, pneumatic pressure, or a combination of the 2 methods. No adaptation of amalgam in natural teeth was attained that would successfully resist ingress of staining solutions, such as mercurochrome. Fillings could be attained in steel dies which withstood 10 to 50 lbs. air pressure. The resistance to pressure varied with time, indicating that amalgams pass through cycles of expansion and contraction. Gold foil fillings and inlays did not leak the staining solution. OEH (9)

Longitudinal Displacement of Rails and Deformation of the Track. (Les déplacements longitudinaux des rails et les déformations de la voie.) R. Levi. *Génie Civil,* Vol. 101, Aug. 1932, pages 179-183. Treats mathematically the proposed advantages of using 30 meter rails in preference to the shorter lengths. Long rails can be used without any fear, but their commercial advantages have to be checked by actual use. JDG (9)

Materials of Chemical Plant Construction. A. H. Loveless. *Industrial Chemist,* **Part III—Lead,** Vol. 8, Aug. 1932, pages 289-290; Sept. 1932, pages 310-312; Oct. 1932, pages 352-353; **Part IV—Iron and Steel,** Nov. 1932, pages 387-390; Dec. 1932, pages 442-444; Vol. 9, Jan. 1933, pages 26-29; **Part V—Refractories,** Mar. 1933, pages 99-101; Apr. 1933, pages 126-128; May 1933, pages 161-163. This series of articles covers a broad field but the articles in themselves contain for the most part generally known information. While the articles are taken from previously published work there is a scarcity of references which one would expect to find in such a series. RAW (9)

Material for High Pressures and Temperatures. (Werkstoffe für hohe Drucke und Temperaturen.) Lufberger. *Elektrizitätswirtschaft,* Vol. 31, May 31, 1932, pages 217-219. Discussion of paper before 34 Annual Meeting of ASTM, Chicago. Contrary to a tendency in the U.S.A. to employ high alloy steels, plain C steels have been replaced by low alloy steels (0.3-0.4% Mo and 6 Cr/0.3-0.5 Mo) steels in highly stressed boilers on the continent. These less expensive steels served their purpose. EF (9)

HEAT TREATMENT (10)

Heat-Treatment of Aluminum Alloys. Douglas B. Hobbs. *Machinery, N. Y.*, Vol. 39, Jan. 1933, pages 319-320. When an Al alloy product is rolled, drawn, forged, extruded, or otherwise cold-worked, it is strain-hardened which results in an increase in strength and a decrease in elongation. In either cast or wrought Al products material is annealed at 650° F. and slowly cooled. By heating the alloy between 900° and 960° F. for a time the soluble constituents of the alloy are brought into solid solution. Tensile properties of some of the more common heat treated wrought and cast Al alloys in the annealed, heat treated and quenched, and heat treated, quenched and aged conditions are shown in a table. Another table shows workability of wrought Al alloys with various heat treatments. RHP (10)

High Lights on Heat-Treating Tool Steels. Wm. C. Betz. *Modern Machine Shop*, Vol. 6, Oct. 1933, pages 22-24. A brief discussion of heat-treating and cooling methods for tool-steels. A chart for converting temper colors to Rockwell hardness is added. Ha (10)

Heat Treating Gray Iron Castings. John W. Bolton. *Foundry*, Vol. 61, Mar. 1933, pages 19-20, 62. From a paper presented before the Cincinnati chapter of the American Society for Steel Treating. Commercial cast Fe are alloys of Fe, C and Si, plus Mn, P and S, and in many cases alloying elements such as Ni, Cr, Mo, etc. Gives the influence of these elements on heat treatment results. Proper use of alloys facilitates heat treatment by quenching. Elements like Cr and Mo may cause difficulty in annealing. Discusses basic principles to be observed in heat treating cast Fe. Lowering of critical range, some stabilization of carbides, and lowering of critical quenching speeds are definite advantages, resulting in easier manipulation, less drastic treatment and greater toughness in finished product. VSP (10)

The Selection and Treatment of Gear Steels. *Edgar Allen News*, Vol. 12, Nov. 1933, pages 339-342. Correct selection of gear steels and their heat-treatment is discussed; they must not give undue wear in service, teeth must not break and they must run noiselessly. The electric heat-treatment as applied to Ni steels by Brown and Co. is described and parts illustrated. Ha (10)

Heat Treatment of Cast Iron. J. H. Bradshaw. *Proceedings Staffordshire Iron & Steel Institute*, Vol. 47, Session, 1931-32, pages 52-57. A general discussion on microstructure, heat treatment, alloy cast iron and the application of the heat treated cast iron. GTM (10)

Some Phases of Modern Heat Treating. P. P. C. Chapman. *Iron and Steel of Canada*, Vol. 16, May-June 1933, pages 67-69; July-Aug. 1933, pages 83-88. Paper presented to Montreal Chapter, A.S.S.T., in which author deals with types of furnace in general use, conditions which must be met for furnaces to be efficient, heat-treatment of welded pressure vessels, and tests needed to ensure their solidity. Principles of heat-treatment are then fully discussed, the paper being copiously illustrated by photographs and photomicrographs. OWE (10)

Heat-Treatment of Gearing. E. F. Davis. *American Machinist*, Vol. 77, May 10, 1933, pages 306-308. The difficulties of heat-treatment of gears are pointed out; correct treatment must not change diameter of pitch circle or shape of teeth in the least or noisy gears result. Oil-hardened gears usually expand permanently in hardening, carburized gears show a little shrinking. Rate of quenching is a most important factor, oil and water quenching both can give very good results when adjusted to the mass to be hardened and the cooling rate is not excessively fast. Cyaniding gives good results with low C steels. The conditions are discussed at length and attention called to the fact that in order to produce satisfactory gears the steel should be treated properly during production as well as during the heat-treatment after it is finished. Ha (10)

Hardening (10a)

Heat-Treatment of Molds for Plastics. E. F. Bachner. *American Machinist,* Vol. 77, Apr. 26, 1933, page 279. General requirements of molds for plastic materials are discussed. Phenolic and urea base materials need steel molds as they have to stand pressures up to 4000 lbs./in.^{2} under temperatures up to 350° F. Steel of low C content is used which is given an outer hard shell of about 1/8" thickness. Ha (10a)

Effect of Initial Structure on the Critical Cooling Rate during Hardening of Carbon Steel (Inflytandet av utgangsmaterialets struktur pa den kritiska avkylningshastigheten vid härdning av kolstal) W. Engel & N. Engel. *Jernkontorets Annaler,* Vol. 117, Aug. 1933, 409-418. A well worked steel rod (1% C) was cut into 3 portions which were respectively (A) untreated, (B) mild heated at 740° C. and (C) overheated to 1050° C. Samples were then hardened from 780° in water after heats ranging from 1 to 32 min. A second series of much finer grain was heated to 830°, hardened in oil, then warmed to 740° and cooled in air. Microphotographs showed the first series to be completely hardened after a 4 minute heat, while the second series showed varying depths of hardening, but never complete hardening even after a 32 minute heat. The explanation is advanced that fine grained material is transformed more rapidly and therefore liberates so much heat in the interior that the hardening stage is passed over. In practice a tough interior with a hard surface may best be attained by hardening fine grained steel. HCD (10a)

Annealing (10b)

Heat-Treatment and Testing of Chains. J. W. Donaldson. *Foundry Trade Journal,* Vol. 48, June 22, 1933, pages 428-429; *Iron & Coal Trades Review,* Vol. 127, July 28, 1933, pages 125-126; *Sheet Metal Industries,* Vol. 7, Aug. 1933, pages 209-211. A review of recent work in Great Britain, Germany, and America. Strain and work-hardening effects can be removed by annealing, and the combined effects of over-straining and annealing do not produce brittleness. For wrought-iron chains annealing can be satisfactorily conducted at 650°-700° C. Steel chains should be normalized at 1000° C. Where steel fittings are attached to wrought-iron chains, they should be removed; otherwise, treatment should be conducted at 1000° C. AWM + Ha + OWE (10b)

Interrelation of Operating Data of Electric Box Furnaces for Strip Iron (Zusammenhang der Betriebsdaten elektrischer Schachtglühöfen für Bandeisen) R. Graenzer. *Elektrowärme,* Vol. 3, Sept. 1933, pages 289-292. On the basis of 1000 charges in a bright-annealing furnace of the box type a formula is developed for the determination of time required to heat a certain charge of strip iron of given dimensions up to a certain temperature with a given temperature difference between inner and outer surface; it follows that the time is directly proportional to the square of the thickness of the charge (ring) and inversely proportional to the required temperature difference. The investigation of the economy of a continually operating batch furnace, that is the ratio of energy consumption per unit time, shows that in practice heavy weights of charge should be used. Ha (10b)

Malleable Annealing Practice with Special Reference to Continuous Plants. J. Fallon. *Foundry Trade Journal,* Vol. 49, Aug. 17, 1933, pages 89-91. An article accompanied by 2 diagrams and dealing with the various factors (handling operations, fuel considerations, organization difficulties, etc.) to be considered when designing factories for continuous malleable annealing practice. Advantages of continuous annealing are savings effected through reduction of castings in circulation, more efficient operation in the finishing department, improved quality of castings produced, marked savings in fuel consumption and annealing-pan depreciation, and clean furnaces due to lack of scale deposition from pans. OWE (10b)

Experiments with Annealing of Ball-Bearing Runners (Anlassversuche mit Kugellagerringen) W. Heinen. *Automobiltechnische Zeitschrift,* Vol. 36, Oct. 10, 1933, pages 491-492. Experiments have shown that tempering at 150° C. of steel for ball bearings eliminates further changes of dimensions by aging, and also warping under heating of operation up to this temperature. This is of particular importance for roller bearings. Annealing of C steels at higher temperatures usually does not have the same effect. Ha (10b)

Case Hardening & Nitrogen Hardening (10c)

Carburizing by Continuous Gas Process Proves Economical. H. M. Heyn. *Steel,* Vol. 92, Jan. 9, 1933, pages 17-19. Deals with the results obtained with several installations of the Eutectrol process as applied to hardening of automotive parts. Hardness of the parts has been extremely uniform and distortion has been eliminated to a great degree. A case of 0.035" is produced in a total time of 6.6 hr. Total cost of carburizing is 0.31c/lb. MS (10c)

Investigations on the Nitrogen Hardening of Steels (Recherches sur le Durcissement à l'Azote des Aciers) B. Jones & H. E. Morgan. *Revue Universelle des Mines,* Series 8, Vol. 9, Aug. 15, 1932, pages 438-440. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 354. Ha (10c)

Hardening in Molten Cyanide. Pt. II-III. H. N. Beilby & W. Nelson. *Heat Treating & Forging,* Vol. 19, Sept. 1933, pages 14, 17; Oct. 1933, pages 42-43. Paper read before the Birmingham Section of the Society of Chemical Industry. See *Metals & Alloys,* Vol. 4, Apr. 1933, pages MA 117. MS (10c)

Are Nitrided Cutting Tools Successful? C. E. Greenawalt. *Machinery,* N. Y., Aug. 1933, pages 753-758. Presents results of tests made by Westinghouse Electric & Manufacturing Co. Early tests made with reamers and form cutters made from special brands of nitriding steels were found to be inferior to high-speed steel tools. Later high-speed steels were nitrided successfully. It was found that growth in the drill after nitriding increased the diameter from 0.001" to 0.0015". Depth of case obtained was between 0.012" and 0.014". The core remains sufficiently soft to prevent breakage. Drills worn under size were brought back to their former size by nitriding. Nitriding, grinding, and Cr-plating of drills increased production per grind from 250 to 2,000. Gives several other applications. Three extensive tables show chemical analysis, heat treatment, hardness, growth and results of tests. RHP (10c)

Theory and Practice of Hardening by Nitriding (Zur Theorie und Praxis der Nitrierhärtung) A. Fry. *Technische Mitteilungen Krupp,* No. 2, 1933, pages 44-47. See *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 10. Ha (10c)

Nitriding of Cast Iron for Hollow Bodies and Superheated Steam Valves (Von der Nitirierhärtung des Gusseisens für Hohlkörper und Heissdampfventilen) Finkel. *Die Metallbörse,* Vol. 23, July 29, 1933, page 958, Aug. 5, 1933, page 990. Best suited analyses for:

	total C	graphite	Si	Mn	S	P	Cr	Al
(A) Centrifugal castings	2.61	1.38	2.58	0.61	0.07	0.096	1.69	1.43
(B) Sand castings	2.65	1.80	2.44	0.60	0.075	0.098	1.58	1.37

The physical properties are improved as follows:

	(A) Centrifugal castings			(B) Sand castings		
Untreated	1.58	39.6	418	1.37	33.53	340
(1) 950° C. annealed slowly cooled	1.62	48.2	302	1.38	40.51	266
(2) Oil quenched from 870° C. and annealed at 600° C. for 1 hr.	1.61	47.8	331	1.32	40.90	270
(3) Nitrided at 510° C. for 90 hours	1.70	46.1	972	1.42	37.52	899

The depth of penetration amounts to 0.38-0.40 mm. Annealing at 950° C. followed by slow cooling facilitates machining. The roughly finished work is then submitted to treatment (2), finished and nitrided as under (3). The higher corrosion resistance of nitrided material as compared with case hardened objects is emphasized. EF (10c)

A New Process for Heat Treating of Rail Ends. J. H. CRITCHETT. *Railway Engineering & Maintenance,* Vol. 29, Dec. 1933, page 601. A hand welding torch has been used since a couple of years to heat rail ends to a temperature above the recalescence point. The rail end was then quenched by pouring a definite amount of water on it and drawn by the torch to a desired hardness degree. The recent improvement consists in a very much larger oxy-acetylene torch and in elimination of water quenching. Due to the large flame, the surface of the rail to be hardened is brought to above 1400° F. before the rest of the rail has been materially heated. The cold rail metal acts as the quenching medium. The rate of quenching is such that the rail is left automatically at the desired hardness. If the original hardness of the rail head was 260 Brinell, the treated metal has a hardness of 350 or better. Apparatus, operation, economy, and principles involved are discussed. WH (10c)

Spot Softening a Nitrided Case. H. H. ASHDOWN. *American Machinist,* Vol. 77, May 24, 1933, pages 330-331. If local softening of nitrided surfaces is required (for instance, for machining or repairing purposes) the material can either be heated to 500°-550° C. and then weld metal fused into the surface to be softened, or, in simpler cases, an ordinary soft steel welding wire may be fused into the spot. The piece can then be renitrided to practically the same hardness as before. Ha (10c)

Quenching (10d)

Quenching with the Oxyacetylene Torch (LaTrempe au Chalumeau oxy-acétylénique) J. GALIBOURG. *Revue de la Soudure Autogéne,* Vol. 24, Oct. 1932, page 2621. Abstract from "Journal de la Société des Ingénieurs de l'Automobile." Quenching method developed by English firm Vickers consists in heating surface of the cold piece with a torch flame up to quenching temperature and then removing the torch quickly, thus allowing surface metal to chill through contact of underlying cold metal. Method can be applied to pieces such as gears. In this case torch flame is made to move like a brush. Skillful operators are needed because there is less than a second between time at which correct quenching temperature is reached and that at which metal begins to melt. Operation is then conducted without heating furnace or cooling media. However, it is advisable to maintain pieces cold through quenching in water. Advantages of process are: (1) Freedom from distortion owing to small surface and depth of metal heated at a time. (2) High superficial hardness obtained. This method can be applied to C semi-hard or hard steels as well as to alloy steels such as Ni, Ni-Cr, Cr-Mo steels. Hardness numbers obtained through this process are given in a table. List of pieces which can advantageously be treated with help of the method is given. FR (10d)

Aging (10f)

Retardation to Age-Hardening Effect in High Strength Light Alloys (Du Retard au Vieillissement des Alliages Légers à Haute Résistance) COQUELIN. *Arts-et-Métiers,* Vol. 85, Oct. 1932, pages 353-356. It is a well known fact that, after quenching, it is possible to work easily light alloys of the duralumin type before age-hardening effect is completed. In some cases it is advantageous to delay effect of age-hardening. Tests have been made to establish effect of low temperatures in this connection. Results obtained lead to the following conclusions: (1) When age-hardening is begun, it is impossible to stop it even at a temperature lower than —10° C. (2) Minimum temperature at which metal must be kept is about —5° C. (3) As soon as metal is withdrawn from the refrigerator, age-hardening proceeds normally and usual mechanical properties are reached (Tensile strength : 45 kg./mm.^{2} and elongation in 100 mm. : 24%). (4) Metal keeps a soft state so long as it is maintained at low temperature. (5) After quenching, metal must be cooled rapidly otherwise it begins to age-harden. Practically the fact has been applied in the plant for maintaining, in refrigerated boxes, rivets in the soft state during the whole day. FR (10f)

Mechanical Properties of Old Boiler Plate (Werkstoffeigenschaften alter Dampfkesselbleche) K. BAATZ. *Stahl und Eisen,* Vol. 53, Nov. 9, 1933, pages 1149-1155. Samples of low C steel boiler plate from 6 old boilers installed in the years 1881-1902, were tested in tension, bend, and impact tests. Decided deterioration in properties was found, the reduction in impact values, ascribed to aging in cold deformed areas, being as much as 40%. The lowered values could be improved appreciably by normalizing. SE (10f)

Aging of Steel Springs. R. W. CARSON. *American Machinist,* Vol. 77, Mar. 29, 1933, pages 202-203. Nature and effect of aging on material and products are discussed briefly. Recent investigations have revealed that aging is greater in cold worked or quenched materials and that the rate of aging increases rapidly with only a very moderate increase in temperature. A table is given for recommended heat treatment of springs of different materials. 16 references. Ha (10f)

The Aging of Mild Steel Sheets. R. O. GRIFFIS, REID L. KENYON & ROBERT S. BURNS. *Preprint American Iron & Steel Institute,* May 1933, 18 pages; *Blast Furnace & Steel Plant,* Vol. 21, June 1933, pages 312-314, 329; *Metal Stampings,* Vol. 6, June 1933, page 172. Type of drawn shapes used in building auto bodies from sheet metal are illustrated. The effect of aging on sheets used for this purpose is important. The stress-strain curve is a very sensitive indication of the amount of aging which the sheet has undergone. Freshly cold rolled sheets have no sharp yield point and do not stretcher strain but aging causes a return of both. Typical stress-strain curves are shown for 1% cold rolling after aging various lengths of time at room temperature, 212° F. and 400° F. A rise in yield point and tensile strength occurs, and the ductility decreases. At each aging temperature the sharp yield point returns at a time depending on the temperature. The higher the aging temperature the more rapidly the effect takes place. Other tests on material cold rolled various other percentages showed the same general relationships between time and aging temperature. The greater the amount of cold rolling the longer was the time required for the recurrence of a sharp yield point, and stretcher straining. Greater amounts of cold rolling can, therefore, be employed to delay the recurrence of stretcher straining, but this procedure can be resorted to in only a limited degree because of the impaired ductility that is also produced by more severe cold working. MS + VVK (10f)

Malleableizing (10g)

Metallography of Good and Faulty Malleable Cast Iron (Beitrag zur Metallographie guten und fehlerhaften Tempergusses) O. BRAUER. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 1, 1933, pages 405-408; Oct. 15, 1933, pages 426-428; Oct. 29, 1933, pages 447-448. Author first discusses American and German methods of malleableizing in general with particular reference to the metallurgical occurrences. Importance of proper relation between Mn and S content in obtaining good structure is especially emphasized. Mn content should not be less than twice S content. With S contents above .2% it is advisable to choose Mn content more than twice S content, with S above .25%, Mn content should amount to triple that of S. Structures of pieces malleableized for 30 hrs. at 960° C. illustrate this. With high S bearing malleable cast Fe a complete disintegration of pearlite is obtained only when a double cycle malleableizing process is used. First 30 hr. cycle is followed by second 30 hr. cycle in which C content is decreased by oxidation of graphite and C content of pearlite. Dangerous formation of pearlite is eliminated only when C content has been decreased by oxidation below .8%. In high S bearing malleable of thin cross-section good structure is obtained by prolonging malleableizing time; for thicker pieces temperature upon cooling should be kept for longer time at or around 720° C. to favor disintegration of pearlite in ferrite and graphite. By this process good structure can be obtained also when Mn content is not sufficient to obtain good structure by common malleableizing process. Proper composition of ore mixture for malleableizing is finally stressed. Too high an amount of virgin ore in mixture brings about heavy scaling. GN (10g)

JOINING OF METALS & ALLOYS (11)

Partially Welded, Partially Riveted Construction of the Loading Platform of a Chemical Plant. (Teils geschweisste, teils genietete Konstruktion einer Versandhalle für eine chemische Fabrik.) W. DOHRMANN. *Bautechnik,* Vol. 11, Apr. 21, 1933, pages 229-230. Description of construction in which electric-welding and riveting are efficiently combined. GN (11)

Brazing (11a)

Fluxes for Brazing Steel. *Machinery,* London, Vol. 41, Jan. 5, 1933, page 408. Results experienced with various special fluxes for brazing steels are discussed. Temperatures at which brazing fluxes change their consistencies are summarized in a table. Kz (11a)

Copper-Brazing Applications Under Atmospheric Control. H. M. WEBBER. *Iron Age,* Vol. 129, Mar. 17, 1932, pages 670-671. Cu-brazed steel tube produced by Bundy Tubing Co., Detroit is similar to sweated tubing made from steel, Cu and brass by the same company. The method is known as the Bundyweld. The tubing is fed continuously through a controlled atmosphere furnace and the Cu, which is applied locally to the joint, flows uniformly through the seams and forms a solid wall structure on cooling. Product shows excellent resistance to vibration, has high radiation efficiency and is ductile from high temperature treatment. Controlled atmosphere for the furnace consists largely of H and CO, supplied by an electrolene producer. VSP (11a)

Hard Alloys Used for Drilling by the Azneft. G. E. VARSHAVSKII & N. L. VARTAMETOV. *Groznenskii Neftyanik,* Vol. 2, July-Aug. 1932, pages 47-54. (In Russian.) Reports of the First All-Russian Conference on Hard Alloys. The brazing of fish tail bits used in rotary drilling with hard alloys is effected either by electric (d.c. current) or acetylene welding. The cutting edge is first covered with a layer, a second and third layer is then added close to the sides. The lower parts of the sides (edges) of the bit must also be provided with a hard alloy because of their wear in drilling operations. The American powdered alloy "Blakor" contains up to 86% of metallic W and its resistance against wear is explained by the W carbides formed in the course of the brazing. The Russian alloy "Dognat" has a ferro-W alloy as the base. It has the advantage of being much cheaper but it wears more rapidly. The alloy "Aznefti t" has a ferro-Cr base and its carbides are softer than those of the above alloys. The alloy "Borium" is obtained in small pieces which are welded individually to the bit, it has W-C base and is characterized by its very high hardness. "Pobedit" is similar to "Borium." "Vokar" contains 8-15% C, 78-86% W, Fe, Mn and other elements. It has the disadvantage of having a varying composition, however, it resists wear to a remarkable extent. "Sormait" is used as base for brazing with "Pobedit" and it is slightly softer. The exact proportions of the metals present in the alloys are not given. AAB (11a)

Practical Experience in Robusco Brazing of Cast Iron. (Erfahrungen aus der Praxis über Rohusco-Gusseisen-Hartlötung.) FREDRICH H. FLIESS. *Zeitschrift für Schweisstechnik,* Vol. 23, Jan. 1933, pages 11-14. See *Metals & Alloys,* Vol. 3, Aug. 1932, page MA 299. RRS (11a)

Brazing with Low-Melting-Point Alloys. R. R. SHUMAN. *Welding Engineer,* Vol. 17, Dec. 1932, pages 19-21. Sil-Fos is a brazing alloy with a melting point of 1300° F. and therefore very suitable for joining non-ferrous metals. Ha (11a)

The Whys of Brazing. J. MULLARKEY. *Industry & Welding,* Vol. 5, Feb. 1933, pages 10-12. A few more difficult brazing jobs for repairs are described. Ha (11a)

Copper Brazing Applications Under Atmospheric Control. H. M. WEBBER. *Iron Age,* Vol. 129, Mar. 10, 1932, pages 602-604. Describes several Cu-brazing furnace installations, the products made and their advantages. Using Cu-brazing process the steel objects are charged into furnaces with controlled atmospheres. The process has had a rather general application in manufacture of tungsten-carbide tools. Discusses method used by Henry Disston & Sons, Inc., in making inserted and solid-tooth disk saws, circular cutters, etc. VSP (11a)

Application of Latest Technic in Brazing Hard Alloys. G. E. VARSHAVSKII. *Groznenskii Neftyanik,* Vol. 2, Nov.-Dec. 1932, pages 26-37 (In Russian). The following alloys in granulated form are used for brazing bit edges: "blekor," "dognat," "stalinit" and "vokar." "Studite," "sormite" and "TSBA" are used in rods and "borium," "pobedit" and "relit" are used in small pieces (the compositions are not given). In the gas brazing method the system "alloy-acetylene-sormite" is used, pieces of the alloy are welded into the body of the bit and are covered with lighter alloy sormite. In the system "alloy-copper-gas" there is no brazing but the pieces of the alloy are welded to the bit by means of Cu using natural gas for heating. The consumption of materials in various methods of welding is: (1) for "alloy-acetylene-sormite" size of bit 11¾ inches "pobedit" 500 g., "sormite" 450 g. acetylene 1090 liters, oxygen 880. (2) For "alloy-copper-gas" "pobedit" 650 g., copper 630 g., oxygen 1025 liters, gas 1150 liters. Up to 40% of the old alloy left on the bit can be utilized when using method (2). Among the electric welding methods the following was found to be satisfactory: Welding with 2 arcs, this requiring 670 g. alloy, 910 g. iron, 35 g. electrode alloy 35 g. C electrodes 45 g. consuming 8.6 kw./hrs. A number of known methods such as that of Alexander, Langmuir, Arkogel are discussed. A flux, the "super-electric-borium" used in some methods is composed of SiO_2 17.4%, CaO 29.8%, Al_2O_3 + Fe_2O_3 6.34%, MgO 0.97%, SO_3 1.37%, caustics 2.38%, volatiles 38.4%. A number of methods which were unsatisfactory are analyzed. AAB (11a)

Soldering (11b)

Fluxes for Hard Soldering and Welding Aluminum (Flussmittel zum Hartlöten und Schweissen von Al) H. REININGER. *Maschinenbau,* Vol. 12, Jan. 5, 1933, page 23. Al and its alloys should not be hard soldered or welded without the use of effective fluxes which are to coagulate with the impurities forming a slag upon the bath or to dissolve undesirable substances to a certain saturating point or to develop volatile products which also pull other impurities to the surface (especially Al_2O_3). Beside this, other chemical reactions have to complete the cleaning process. Especially the alkalibisulphates are useful by freeing HCl and HF from the chlorides and fluorides present which then react with Al_2O_3 developing the volatile $AlCl_3$ or AlF_3. The melting point of the flux should be about 30° C. below that of the welding rods or solders thus flowing and spreading out prior to these and preventing oxidation. A change of the melting point is obtained by adding variable amounts of KCl, LiCl or $BaCl_2$ to the other constituents. RV (11b)

Soldering the Rustless Steels. V. W. WHITMER. *Iron Age,* Vol. 129, Apr. 7, 1932, page 833. See *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 173. VSP (11b)

Soft Solders and Fluxes. O. F. HUDSON. *Metal Industry,* London, Vol. 42, May 5, 1933, pages 468-470; May 12, 1933, pages 494-496. The different kinds of soft solders are reviewed, their mechanical properties tabulated and discussed. Sn-Pb alloys are most generally used; other alloys are Sn-Pb-Sb, Pb-Sn-Cd; the eutectic ternary Pb-Bi-Sn has a melting point as low as 96° C. and is used for special purposes. 7 references. Ha (11b)

Soldering Cast Iron (Bewertung von Gusseisenlötungen) BARDTKE & MATTING. *Autogene Metallbearbeitung,* Vol. 25, Dec. 15, 1932, pages 370-378. Quality of a soldered joint depends on cohesion and affinity of metals to be joined by solder and flux also has a great influence. Several kinds of solders were tried and compared among themselves and with welded joints. Strength of soldered joints was usually practically sufficient although values obtained were greatly dependent on incidents. Economy was unfavorably influenced by high cost of solders which could be reduced by employing strength butt-joints. Above 20 mm. thickness, however, a reliable joint had to be made by V or X connections. Soldering has advantage over welding that part to be repaired need not be placed in a mold. Borax alone could not be used as a flux. Ha (11b)

Repair of Large Castings (Die Reparatur grosser Gussstücke) W. ANDERS. *Der Autogen Schweisser,* Vol. 6, Apr. 1933, pages 46-47. Discussion of repairs by means of "Gusseisenhartlötung" or cast iron hard soldering. Kz (11b)

Solderal—A New Aluminum Solder. *Metal Industry,* London, Vol. 41, Nov. 25, 1932, page 523. Claims to be useful for all kind of Al-work, possesses great strength and is easy to use. Ha (11b)

The Diffusion of Heavy Metals in One Another and of Aluminum in Zinc, Tin and Their Alloys (Über die Diffusion von Schwermetallen ineinander und von Aluminium in Zink, Zinn und deren Legierungen) A. MERZ & E. IMBUSCH. *Metallwirtschaft,* Vol. 12, May 26, 1933, pages 295-297; June 2, 1933, pages 311-314. An apparatus was developed for measuring the height of a column of molten metal in an electric furnace. By dilatometric and thermal measurements it was determined that pure Zn is not a polymorphic metal. The speed of diffusion of Zn from a ternary Pb-Sn-Zn alloy into binary Pb-Sn solder at 370° C. was determined. The diffusion constants of Al in Zn and Sn for 610 to 710° and of Al from ternary Al-Zn-Sn into binary Zn-Sn alloys at 610° were determined. The diffusion constants of molten metals are independent of the concentration. Most of the commercial soft solders for Al composed of heavy metals corrode easily and the hard solders, rich in Al, have a high melting point. A suitable Al hard solder consists of a ternary Al-Zn-Sn alloy, high in Al, with enough Sn to produce rapid diffusion and low melting point and enough Zn to form a ternary solid solution. The Sn content should be higher than the Zn content. 8 references. CEM (11b)

Welding & Cutting (11c)

Welding of Rails Onto Ties (Schienenbefestigung durch Schweissen) BLOSS. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 88, Mar. 15, 1933, pages 119-120. Two possibilities of welding the lower flange of rails onto a sole plate resting on wooden or steel ties respectively are discussed. The seams should not be extended to the underside of the rail base. The arrangement of the seams must be accomplished in such a manner as to avoid tilting and lateral displacement of the rail in case a welded seam fails in service. The use of wider steel ties is advocated. EF (11c)

Influence of Slag Inclusions on Quality of Weld with Electric Resistance Butt Welding (Der Einfluss von Schlackeneinschlüssen auf die Güte der Schweissnaht bei der elektrischen Widerstands-Stumpfschweissung) H. BLOMBERG. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, May 6, 1933, pages 475-477. Failures in fusion welding have often occurred for which a reasonable explanation could not be given, although usually a fusion-butt-weld shows more than 100% of the tensile strength of the non-welded material. Tests and their metallographic investigation clearly showed that in all such cases numerous hollow spaces existed in the weld, and that, simultaneously, the original material had many slag inclusions. It is therefore absolutely necessary to use only inclusion-free steels and to weld in as short a time as possible, to employ a sufficiently large welding generator and an automatically regulated welding machine. Ha (11c)

Free Bending Test (Der Freibiegeversuch) E. BLOCK & H. ELLINGHAUS. *Die Elektroschweissung,* Vol. 4, July 1933, pages 126-129. The authors developed an apparatus for bend tests on welds in which no mandrel is used since large fluctuations are apparent in bending welded specimens over mandrels or rolls. The apparatus is first described and shown in detail. Tests were made on homogeneous, i.e. non-welded bars of various thickness and on X- and V- butt welded plates of 5, 10 and 15 mm. thickness with a tensile strength varying from 34-140 kg./mm.^{2} Tests show that the part of the test bar participating in deformation is uniformly loaded during the whole course of the test. The characteristic of elongation is practically alike for samples of various tensile strength, i.e. the angle of bending is in all cases a yardstick for the bending test. Further advantages of the new bending device are: test bar need not be machined since the weld seam does not hinder the bending as is the case in bending tests over mandrels. Measuring length of the bar can be smaller than with the former type of bending test. To operate the new bending device a simple block and pulley is required so that even small shops can make the test. The new method is an excellent means to check the work of welders and to test properties of welds made according to various welding methods. GN (11c)

Requirements for Modern Resistance Welding Machines (Welche Anforderungen können an moderne Maschinen für elektrische Lichtbogenschweissung gestellt werden?) WOLF VON BLEICHERT. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Aug. 20, 1933, pages 453-454. Author gives the following rules for judging arc welding machines which are to fulfill following requirements: (1) welding properties: (a) creep characteristic, (b) suitable current type, (c) practicability, (2) universal applicability: (a) weatherproof and stable, (b) movable, (c) connectable to various primary voltages, (d) possibility of switching parallel with similar machines, (e) additional apparatus for smallest welding currents, (3) efficiency: (a) low first cost, (b) high efficiency, (c) low idle capacity, (d) simple construction. GN (11c)

Welding Stainless Steel. D. S. BLACK. *Electrical Review,* May 19, 1933, page 702. Austenitic group of stainless steels is most suitable for welding. Cold welding and cold working should be avoided as much as possible. Atomic H process is best. Spot welding can be satisfactory if conditions are carefully studied and close temperature control is obtained. Expert arc welding is better than expert acetylene welding. Direct current is considered better than a.c. because of better control of the supply. Abrasive methods of cleaning are being superseded by pickling. MS (11c)

Helical Joints in Welded Cylindrical Pressure Vessels. G. W. BIRD. *Mechanical World & Engineering Record,* Vol. 93, May 12, 1933, pages 454-455. Since the resultant stress in a helical joint is less than in a longitudinal joint, its use allows of plate thickness being reduced. Author shows that the stress increases with the angle of the helix and points out that the length of the joint increases as the plate thickness is reduced. Kz (11c)

Welding. L. C. BIBBER. *Marine Engineering & Shipping Age,* Vol. 37, Dec. 1932, pages 507-508, 513; discussion, pages 523-524. Results of U. S. Navy tests on welded longitudinal seams for ship plating are discussed and presented in tabular form. The shell of a ship having lapped seams and butts welded with electrodes giving deposits having an elongation in 2" of 20% and an ultimate tensile strength of 65000 lbs./in.^{2} would be feasible. The main problem in such a project would be those of shrinkage, erection, and cost, not strength. Kz (11c)

Manufacture of Ordnance Revolutionized Thru Arc Welding. G. M. BARNES. *Machinery,* London, Vol. 40, Sept. 1, 1932, pages 689-690. See *Metals & Alloys,* Vol. 4, June 1933, page MA 181. Kz (11c)

Investigations in the Welding of Pressure Vessels. *Commonwealth Engineer,* Vol. 19, Oct. 1, 1932, page 80. Drawbacks to acoustic, X-ray and magnetic inspection of welded joints are criticized and "excellent possibilities for practical application" are seen in the following "straight away" examination method originated in Germany. The special apparatus consists of an electrically driven vertical milling machine which is tack welded on to the top of the joint and a forward travel makes the hole oval and allows an increased area of weld metal to be examined. It is a simple matter afterwards to fill in the hole with fresh weld metal. The hole when made can, if so desired, be etched to make evident the various runs of metal. For vertical and overhead welds, metallic arc welding is recommended in place of oxy-acetylene welding as it is more difficult for the operator to apply the latter process with success. WH (11c)

Developments in Welding Practice. *Commonwealth Engineer,* Vol. 20, Feb. 1, 1933, page 204. Refers to paper of H. E. Grove before Victorian Institute of Engineers, stating that the use of small runs and heavy welding currents produced welds which were not only sound in their physical properties, but more economical to produce. The speaker gives data on how he used small runs of weld deposited from larger electrode gages at higher welding currents in place of larger runs with smaller gages. The costs of a No. 10 gage mild steel electrode at 110 amps. was 58% greater in material cost and 92% greater in labor and overhead cost than the unit cost of making it with No. 6 gage mild steel electrode at 225 amps. Impact tests in combined tension and bending showed that a welded specimen could be made nearly 100% stronger than an unwelded one cut from solid mild steel. WH (11c)

Hardening of Welded Seams (Härtbare Schweissnähte) *Der Autogen Schweisser,* Vol. 5, Jan. 1933, pages 9-10. To produce welds with properties equal to those of the parent metal, suitable welding rods from alloys with similar metallurgical character as the work piece must be chosen. Kz (11c)

Improved Electrical Welding of Aluminum (Verbesserte elektrische Aluminium-Schweissung) *Aluminium,* Vol. 15, May 15, 1933, pages 5-6. A new welding rod is described with a coating which protects the molten material from the atmosphere and prevents the formation of alumina (Al_2O_3). The slag formed is of lower specific gravity and remains therefore on the surface of the molten metal thus protecting it from oxidation. The strength of the weld is equal to that of the solid material. Ha (11c)

Electric Tube Welder Uses Series of Flat Contacts. *Steel,* Vol. 91, Aug. 29, 1932, pages 24-26. Description of new welding machine for producing electrically welded tubing. The usual Cu rollers are replaced by flat-faced electrodes mounted on circular carriers which travel with the tube as the seam is welded. These electrodes provide a uniform contact area and permit exact control of the intensity and duration of the current, thereby eliminating overheating, sparking, and deformation of the tube wall. JN (11c)

Welding of Small Boats (Das Schweissen kleiner Schiffe) *Zeitschrift für Schweisstechnik,* Vol. 23, Apr. 1933, pages 114-116. General description of a welded canoe. RRS (11c)

"Metallic Joinery" on Gasworks. *Gas Engineer,* Vol. 57, July 1932, pages 403-404. Pioneer work in electric welding as outlined by H. E. Grove in a paper before the International Association of Bridge and Structural Engineers. WH (11c)

Welding of Aluminum and Duralumin (Schweissen von Aluminium und Duralumi-nium) *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 23, July 28, 1932, page 439. Preheating to 260° and 400° C. respectively is desirable but not always essential. A flux for prevention of oxidation is important. Instructions on the welding technique are furnished. The welding rod for duralumin should contain 50% Si. After welding wash and brush with hot water, heat in a furnace to 480° C. and quench in water or oil. Kz (11c)

Welding of Elektron-castings (Schweissen von Elektronguss-Gehäusen) *Zeitschrift für Flugtechnik und Motorluftschiffahrt,* Vol. 23, Aug. 12, 1932, page 474. Welding of elektron-castings will be easier than that of Al alloys if elektron-welding-rods "AZ 1" and a flux designated as "Rostosky-Flussmittel" are used. Strength of the weld will be 100% or even more and the weld is corrosion resistant. Heat treatment at 300° C. before and after the welding is essential for strain relief. Kz (11c)

Wrought Iron Welded by both Plastic and Fusion Processes. JAMES ASTON. *Iron Age,* Vol. 129, June 16, 1932, pages 1282, 1335. See *Metals & Alloys,* Vol. 4, Feb. 1933, page MA 40. VSP (11c)

Better Production and Better Welds. W. A. ANDERSON. *Welding Engineer,* Vol. 17, Sept. 1932, pages 44-45. Employment of only modern equipment in resistance welding is stressed as means for economical and good quality production. Control mechanisms for machine welders are described and a few examples of quantity production with spot-welding given. Ha (11c)

Arc Welding of Aluminum and a Few Properties of Weld Metal (Die Aluminium-Lichtbogenschweissung und einige Eigenschaften des Schweissmetalles) L. ANASTASIADIS. *Zeitschrift für Metallkunde,* Vol. 25, Apr. 1933, pages 97-98; June 1933, page 141. Brief discussion of the possibilities of arc welding Al, with some test data. Halogen salts were used as fluxes. Details in welding technique are given, and several welds illustrated and described. To be continued. RFM (11c)

Structures Offer New Fields for Arc Welding. G. D. FISH. *Railway Engineering & Maintenance,* Welding Number, Feb. 1933, pages 80-83. A review is given of the progress made with special reference to the reinforcement and repairing of old bridges. As compared with riveting, the more compact connections, saving of connection material, absence of rivet holes, simplified fabrication and cheaper field work are emphasized. No angles are required for plate girders. Stiffeners consist of plates set edgewise to the web. Very reliable forms of welded constructions have been worked out for gusset joints, chord splices, bearing pedestals, knee braces, sway bracing and lateral bracing connections, stringer and floor beam connections, plate girder sections, girder splices, web stiffeners, and most other details required in bridge construction. WH (11c)

Repairing a Boiler Damage by Electric-Welding (Ausbesserung eines Kesselschadens mittels elektrischer Schweissung) M. REICHNER. *Die Wärme,* Vol. 58, Mar. 25, 1933, page 186. Leakage of the connection piece between boiler bottom and feed valve due to advanced state of rusting was overcome by built-up welding. EF (11c)

Welded Pipe Line Members (Geschweisste Rohrleitungsteile) E. KASCHNY. *Die Wärme,* Vol. 56, Mar. 4, 1933, pages 142-145. Possibilities of water gas, oxy-acetylene and electric welding with reference to pipe lines and pressure vessels are described in full detail and the most representative cases illustrated. EF (11c)

Thyratron Control of Welding in Tube Manufacture. H. W. LORD & O. W. LIVINGSTON. *Electronics,* Vol. 6, July 1933, pages 186-187, 206. Ordinary spot welders do not produce ideal welds: (1) manual control erratic; (2) time delay relay method requires long time because of non-synchronous action of contactor; (3) with synchronous motor driven contacts, occasional sparks impair accuracy. Grid-controlled rectifiers provide a solution. Circuit is described; some limitations stated; several examples reported. Conclusion is that higher initial cost is warranted by superior results. MFB (11c)

Fabrication by Welding. E. DACRE LACY. *Electrical Review,* Vol. 112, Jan. 20, 1933, page 80. Describes application of arc welding for fabrication of circuit-breaker and transformer tanks, frame brackets for switch gear, bed-plates, stator frames, and cubicles for housing switch-gear. MS (11c)

Fabrication by Welding. E. DACRE LACY. *Electrical Review,* Vol. 112, Mar. 24, 1933, pages 411-412. Discusses use of electric welding for repair of cars, wheels, motor casings, gears, and permanent way. MS (11c)

Magnetic Testing of Weld Joints and Work Pieces (Magnetische Prüfung von Schweissverbindungen und Werkstücken) J. PFAFFENBERGER. *Die Elektroschweissung,* Vol. 4, July 1933, pages 135-136. The new method described has been developed by the I. G. Farbenindustrie in coöperation with the Allgemeine Elektrizitätsgesellschaft. The principle is as follows: The piece to be tested is magnetized by 2 permanent magnets, the course of the magnetic field is determined by means of a tapping instrument coupled with amplifier and head phone. Disturbances of the magnetic field point to defects (pipes, cracks, etc.) each causing a characteristic change of sound in the telephone. Simple welds as well as difficult joints can thus be tested. The method is simple, quick and fit for permanent control of weld seams. GN (11c)

Arc Welding Hazards. F. S. PEASLEY. *Welding News,* Vol. 3, July-Sept. 1932, pages 36-38. Common hazards in arc welding are due to improper protection by goggles and garments, insufficient ventilation of booths or rooms, failure to indicate or mark hot material or stock, insufficient training of operators. Zinc oxide is best for marking as it absorbs 100% of the rays of the arc. Protection of the eyes is most important. Ha (11c)

Theory and Practice of Modern Gas Cutting (Theorie und Praxis des modernen Brennschneidens) HANS MELHARDT. *Zeitschrift des Österreichischen Ingenieur- und Architektenvereins,* Vol. 85, July 21, 1933, pages 163-168; *Der Autogen Schweisser,* Vol. 6, Apr. 1933, pages 41-45; May 1933, pages 59-64; June 1933, pages 69-71; July 1933, pages 87-89. Other types of shaping have successfully been replaced by gas cutting. Formerly cast, forged or pressed work pieces are nowadays shaped in many cases by gas cutting. The physical occurrences of the process are considered. Gas cutting is based on the fact that a material heated to its burning point temperature burns in the O stream and can thus be cut, provided the burning point is below the melting point. However, when the burning point is higher than the melting point the material is merely fused but not cut. Fe-C alloys can be gas cut only when, with increasing C content, the melting point is not lowered to or below 1350° C., the burning temperature of Fe. Therefore, cast Fe requires a special method of gas cutting. Mn and Mn steels can be well cut, Si cannot be cut, but Si steels with up to 4% Si. Cr steels with up to 1.5% Cr can be thus worked but neither stainless Cr nor Cr-Ni steels. Ni steels with up to 34% Ni can be gas cut provided C is below .5%. Cu and Al cannot be worked by gas cutting. Kz + GN (11c)

Welding Investigations. *Commonwealth Engineer,* Vol. 20, Jan. 2, 1933, pages 167-168. A review of the technical report of the Royal Insurance Co., Ltd., on welding. The German "straight away" weld testing machine, consisting of an electrically driven vertical milling machine which is tack welded on to the top of the joint is warmly recommended. The frequency of entrapped slag by the use of too low a current and excessive "wearing" of the electrode in arc welding with covered electrodes is pointed out in several places in the report. Some of the conclusions in regard to overhead and vertical welding state that there is the most difficulty in obtaining penetration to the back of the plate with the former method. This holds also for a heavily coated electrode although a good quality weld metal is secured when the plate lies overhead or is vertical with the weld horizontal. With a slightly coated electrode the danger of entrapped slag is decreased and when the plate and weld are both vertical, better penetration to the plate is to be expected. The metal during its passage through the arc is likely to be more contaminated by the atmosphere than when a more heavily coated electrode is used. The tests on bare wire welds showed that sound metal can be laid for each type of weld. The Izod values for vertical and overhead welds need be no lower than they are for horizontal welds. In general for vertical and overhead welds, especially the latter, oxy-acetylene is more difficult to apply than metallic arc welding. The use of bare wire in the metallic arc welding of pressure vessels is condemned. The low impact strength is critically commented on. The high quality obtainable in electric resistance welds in steel is stressed in the report. Over 1% Mn in the deposit metal almost completely prevents the formation of nitride needles, but even 10% Mn does not prevent the absorption of nitrogen, sometimes present as high as 0.14%. Covering is most effective agent in keeping atmospheric contamination low. The Izod test for weld metal is urged which excludes bare wire and inferior electrodes. The procedure from wide weaved runs should be changed to such sized runs as will prevent overheating of the weld metal with consequent reduction in Izod values. WH (11c)

Comments on Design of Welded Spur and Bevel Gears. C. S. LINCOLN. *Welding Engineer,* Vol. 17, Nov. 1932, page 28. Disadvantages are pointed out in making welded spur and miter gear; if the kind of material for the different parts is too different in properties no satisfactory piece may be produced. Ha (11c)

Scientific Management in Spot Welding (Méthodes et Organisation ou Travail de Soudure par Points) M. LANGUEPIN. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Mar.-Apr. 1932, pages 591-609. Lecture before the Société des Ingénieurs Soudeurs. Study is given to (1) Shape and size of members. (2) Importance of welding work. (3) Setting. Handling of the pieces is then dealt with. In concluding the cost of the spot welding method is studied. FR (11c)

Construction of Hospital Furniture by Welding (La Construction par Soudure Autogène des Meubles d'Hopitaux) R. MESLIER. *Revue de la Soudure Autogene,* Vol. 24, July 1932, pages 2556-2557. Description of chairs, shutter trucks, dentist arm-chairs, beds, instrument cupboards is given. FR (11c)

Origin, Nature and Significance of Thermal Shrinkage Stresses (Entstehung, Wesen und Bedeutung der Wärmeschrumpfspannungen) KRABBE. *Die Elektroschweissung,* Vol. 4, May 1933, pages 85-87. Theoretical considerations on such stresses showing that the sole cause of the plastic deformations thus effected and subsequently of the shrinkage stresses is the variability of the modulus of elasticity. All occurrences of shrinkage stresses can be explained by this fact. The author's theoretical considerations check the results of the practical tests of J. Dornen, Schrumpfungen an geschweissten Stahlbauten, *Der Stahlbau,* Vol. 6, 1933, No. 3. After these considerations the practical importance of shrinkage stresses is discussed for an I-profile regardless whether it is welded or rolled. These considerations refer to the profile subjected to (1) tension, (2) compression, (3 bending. GN (11c)

Dynamic Characteristic of Welding Machines (Dynamische Charakteristik von Schweissmaschinen) KARL MELLER. *Die Elektroschweissung,* Vol. 4, June 1933, pages 101-110. Whereas the static characteristic of welding machines denotes the relation between amperage and voltage the dependence of current and voltage on time is defined as dynamic characteristic. In particular the relation of the momentary occurring peak current to the permanent current is a characteristic for judging the dynamic characteristic. In this paper our present knowledge on these conditions is summarized and critically considered. It is pointed out that suitable methods are still to be devised to establish correct characteristics of welding arcs under various conditions of operation. If this can be attained it probably will be possible to express numerically the welding properties that welding machines have to meet under actual service conditions. GN (11c)

Economic Scrapping of Ships (Wirtschaftliches Abwracken von Schiffen) W. JOHAG. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, Mar. 15, 1933, pages 107-109. Cutting applied to breaking up old ships gains increasing importance. A diagram is presented showing the efficiency of cutting differently sized sheets by (1) shears, (2) gas, (3) knocking off of rivets by hand and (4) burning the rivets off by gas. A second diagram reveals the gas consumption in liter/meter (city gas 2 : 1, hydrogen 4 : 1, and C_2H_2 1 : 1) in relation to the sheet thickness. WH (11c)

Atomic Hydrogen Welding Used to Repair Dies. *Iron Age,* Vol. 130, Oct. 20, 1932, page 612, adv. page 18. Discusses method used by the Meriam Co., Cleveland, for repairing dies used in making forgings, die castings and permanent mold castings. It is not used successfully for welding Al, brass, the bronzes or zinc-base die castings. Another use made of process is for repairing surfaces of W steel dies. Describes procedure. VSP (11c)

Arc Welding in Machine Design. *Machinery,* London, Vol. 41, Mar. 9, 1933, pages 665-669. To secure satisfactory service, the working stresses in the various sections of the construction have to be analyzed. To determine complex stresses celluloid models have to be made. Exposed to polarized light, they show the distribution of the internal stresses by colored interference bands. A change in the contour adopted for welded plate construction eliminates danger zones. Redistribution of metal to put it where it is needed to carry loads rather than where it will assist the foundryman and machinist, are possible by welding. Construction of a 500-ton press by welding is discussed. Amount of steel was reduced by 13%, yet new design is 4 times as stiff and involves stresses that are less than half those encountered in the casting. The weight of the welded-steel frame is 40,000 lbs. and the total cost £600, as compared with 70,000 lbs. and £1,110 of the steel casting. Kz (11c)

Welded Constructional Work. *Mechanical World & Engineering Record,* Vol. 93, Apr. 14, 1933, page 360. A practical example of welded construction work is discussed and the advantages of welded over riveted structural work are given. Kz (11c)

Welding Methods for Non-Ferrous Metals (Schweissverfahren für Nichteisenmetalle) *Die Metallbörse,* Vol. 23, Feb. 4, 1933, pages 146-147; Feb. 11, 1933, page 178. In introduction the marked differences between welding of ferrous and non-ferrous materials are pointed out. The utilization of microstructure investigations in the welding performances of non-ferrous material is emphasized. Electric welding of Al (spot-welding) has been perfected. Absence of coarse recrystallization and oxidation are ascertained. Gas inclusions are sometimes encountered in spot and seam welding. Butt welding represents the most successful welding method for Al. Gas welding (O_2/H_2 and O_2/C_2H_2) and electric arc welding are also applied with success. Oxygen/hydrogen welding permits better control of the welding temperature. Oxygen/acetylene is applied to heavy sheets or plates. The following are the prerequisites (1) the flame should not deposit C, (2) an excess of O_2 must be avoided, slightly reducing being best. The following are results gained on Al sheets:

Sample	Welding method	Tensile strength in kg./cm.^{2}	Elongation %
1	gas fusion welding	1000	35
2		1075	35
3		750	46
4	metal electrodes	1180	14
5		2560	3
6		2060	5
7	carbon electrodes	2180	13
8		2280	6
9		3080	7
10		2740	3

Porosity occurs when using metal electrodes due to relatively short sodification times. High tension currents eliminate this drawback to a certain extent. C electrodes are mostly used for lap welding jobs. Electric resistance welding is most successfully applied to light parts. The difficulties met with in welding of Cu are greatly reduced. Short welding times proved to be very essential. By means of cold working the tensile strength can be raised at the expense of elongation. Butt welding gains more and more importance. The welding of brass yields the better results the lower the Zn content. Increasing welding times furnish softer but less strong welds. Seam welding is more frequently employed. Electric butt welding is restricted to drawn material with less than 40% Zn. EF (11c)

Manganese Steel Now Successfully Welded. *Mining & Metallurgy,* Vol. 13, Apr. 1932, pages 198-199. Early failure of Mn steel welding was due to weakness and brittleness of the metal near the weld caused by heat of the arc. Reason was that Mn steel contains approximately 1.25% C which is easily damaged by heating close to its melting point. Taylor-Wharton Co. developed a welding rod known to the trade as "Timang." Success of the welds is due to freedom from liberated carbides. VSP (11c)

Fusion Welded Boiler Drums. *Power Engineer,* Vol. 27, Sept. 1932, pages 328-329. Reference is made to a method of welding boiler drums developed by the Babcock & Wilcox, Ltd., which is claimed to be superior to the usual riveted construction. WH (11c)

The Application of Acetylene Welding to Battery Repairs (Die Anwendung der Azetylen-Sauerstoffschweissung zur Reparatur von Bleiakkumulatoren) Ernst Greger. *Der Autogen Schweisser,* Vol. 6, May 1933, pages 57-59. Discussion of 6 different lead soldering processes. Technical instructions to be observed in repairing batteries by means of the acetylene welding are furnished. Kz (11c)

Electrodes with Special Coatings for Production of Deposits with an Increased Hardness. A. P. Goryachev, P. P. Syromyatnikov & V. G. Matveev. *Welding,* Vol. 3, No. 7, 1932, pages 18-21 (In Russian). Electrodes of unknown analysis were coated with mixtures containing chalk and either Fe-Mn or Fe-Cr to which different amounts of graphite were added. An increased C content and good welding of base and deposited metal was accomplished in every case, but deposited metal was always too brittle. (11c)

Electrodes with Heavy Coating for Welding Soft Steel. A. P. Goryachev, N. M. Nikitinykh & G. I. Martyanov. *Welding,* Dec. 1932, pages 3-7; Jan. 1933, pages 13-15 (In Russian). A comparison was made between low C electrodes coated with a thin layer of chalk mixed with water glass and electrodes coated with a heavy layer composed of 1-1.4% Al_2O_3, 22-33.6% Fe_2O_3, 64-50.4% of pyrolusite and 13-15% of chalk. For the best results thickness of 1 mm. is required for electrodes up to 3 mm. in diameter and 2 mm. for electrodes 4-6 mm. diameter. Heavy coating gives better penetration, flattens the bead and gives a weld of better physical properties. (11c)

Stress Distribution in Welded Sheet Beams (Spannungsverteilung in geschweissten Blechträgern) Karl Girkmann. *Stahlbau,* Vol. 6, June 9, 1933, pages 98-102. Author shows that cases of application of welded sheet beams are possible in which the actual stresses of the material considerably surpass calculated values. In most cases, however, these local overloads due to nonuniform stress distribution in the tie plates and to deformation of the welds are relatively small. GN (11c)

Welding in Foundry (La Réparation des pieces de Fonderie par Soudure Autogène) Henri Gerbeaux. *Bulletin de l'association Technique de Fonderie,* Vol. 7, Jan. 1933, pages 1-15. Electric welding and oxy-acetylene welding of ferrous and non-ferrous metals are discussed in detail. GTM (11c)

Repair of a Winding Machine Frame by Means of Welding (La Réparation d'un bâti de Machine à Rouler par Soude-Brazure) H. Gerbeaux. *Revue de la Soudure Autogene,* Vol. 24, July 1932, pages 2562-2563. Description of the repair on a cast iron frame of 45 mm. thickness is given. FR (11c)

Electric Arc Welding. E. P. S. Gardner. *Electrical Review,* Vol. 112, Jan. 20, 1933, pages 85-86. Includes discussion. Abstract of lecture before the London Technical Group of the Electrical Power Engineers' Association, dealing with applications to various forms of construction and repair work. MS (11c)

Economic Results on Flanges Built Up by Welding (Wirtschaftliche Ergebnisse der Spurkranzaufschweissung) Grüter. *Die Eisenbahn-Werkstätte,* Vol. 41, July 20, 1933, pages 119-121. Several detailed cost sheets are presented relating to building up of flanges worn in service. Before starting the repair work on the wheel flange delivered at the shop, a diagram is taken by means of a recording slide gage to ascertain the contour of the worn flange. WH (11c)

Tests on Various Designs of Rolled Shipbuilding Profiles and Electrically Welded Connections (Konstruktionserprobungen an gewalzten Schiffbauprofilen mit elektrisch geschweissten Verbindungen) B. P. Haigh. *Werft, Reederei und Hafen,* Vol. 14, July 1, 1933, page 185. Summarizes experiments carried out at the Royal College in Greenwich before the Meeting of the Institution of Naval Architects London, April 1933. The speaker arrives at the conclusion that welded symmetrical profiles connected in suitable fashion are by far superior to unsymmetrical profiles jointed by riveted knee braces widely employed at present. WH (11c)

Welding Pioneering Work in Industry. (Schweisstechnische Pionierarbeit in Handwerksbetrieben.) E. Stursberg. *Die Schmelzschweissung,* Vol. 11, Oct. 1932, pages 217-223. Although employment of welding technique and methods is more a matter of large industrial development it is pointed out that in spite of limited means and equipment even small plants and individual craftsmen shops can make successful and profitable use of welding in repairing, replacing and decorative work. This is illustrated by examples in welding of cast Fe, Al and other metals. Heating, handling and preparing of the work is treated in detail. Ha (11c)

Methods Used by C. E. Co. for the Training of Welding Operators and Inspectors. John S. Strong. *Journal American Welding Society,* Vol. 12, Apr. 1933, pages 13-15. Paper presented at Dec. 16, 1933 Meeting, Chicago Section, American Welding Society. An outline of (1) The status of welding technique and knowledge in the author's organization prior to instituting training program, (2) the objectives of the program, (3) features of the training course, (4) results to be expected from such a program. TEJ (11c)

Open-Hearth Charging Boxes Will Test Welded Construction. Harry E. Stitt. *Iron Age,* Vol. 130, Aug. 11, 1932, page 221. Describes the use of welded open-hearth charging boxes at plant of Otis Steel Co. Open-hearth charging boxes were selected because: they are subject to severe heat and strains; they permit variation in design for purposes of comparison; and they can be introduced into regular operation without awaiting new construction. Report will be published showing results of tests. VSP (11c)

Stresses in Branch Connections. Herbert P. Smith. *Journal American Welding Society,* Vol. 12, Apr. 1933, pages 19-21. Paper presented at Jan. 1933 Meeting, Pittsburgh Section, American Welding Society. Description of some tests which showed the advantages of manufactured welding fittings instead of right angle branch connections. TEJ (11c)

Dust Separators Operating at 250-Lb. Pressure Fabricated by Welding. E. W. P. Smith. *Iron Age,* Vol. 130, July 14, 1932, page 65, adv. sec. page 18. Shielded arc welding process is used in construction of pressure vessels designed to conform to code and insurance requirements. Poor fusion can be corrected by increased welding heat and more careful application of process. Oxides and nitrides are excluded by shielding the arc. This process may be used on pipe lines, tanks, barges and other units where strength and speed of construction are major objects. Describes work of Ohio Machine & Boiler Co., in construction of dust separators. VSP (11c)

Designing and Testing Welds in High-Pressure Vessels. William Spraragen. *Iron Age,* Vol. 129, Feb. 4, 1932, pages 340-343, adv. sec. page 30. Welded construction permits testing of vessels at hydrostatic pressure several times working pressure. Correct design for eliminating high local stresses is on ellipsoid with a ratio of 2 to 1 between major and minor axes. Requirements for testing and inspection are more rigid than for riveted vessels. Hammer test is required while under pressure, after which hydrostatic pressure is raised to 2 times allowable working pressure. Chemical analysis should not show more than 0.03% N as iron nitride. Minimum sp.gr. to be 7.80. Describes Kinzel-Miller safe working fiber stress as required by A. S. M. E. VSP (11c)

Covered Electrodes versus Bare Wire. E. F. Spanner. *Welder,* Vol. 4, Jan. 1933, pages 24-27. Compares experiences in America and England with bare and covered electrodes in ship welding; tests so far permit following conclusions: (1) Bare electrode welding is not suitable for longitudinal seams of shell plating and other strength members of ships in which longitudinal stresses are of any great magnitude, and (2) shell of a large ship having lapped seams and butts welded with covered electrodes of suitable quality is perfectly feasible at present stage of art of welding; main problems still to be overcome would be shrinkage, erection and cost. Ha (11c)

Welded Steel Frames for Diesels. C. H. Stevens. *Electrical Review,* Vol. 111, Oct. 28, 1932, page 638. Abstract of a paper read before the Diesel Engine Users' Association. Describes methods whereby the strength of the welded structure can be made to depend upon the component members, which are arranged to carry the primary loads, the welding serving merely as a means of joining the various load-bearing members together. MS (11c)

Technique of Artistic Forging and Fusion Welding. (Kunstschmiedetechnik und die Autogenschweissung.) J. Blümmel. *Der Autogen Schweisser,* Vol. 5, Nov. 1932, pages 229-234. Illustrated article discusses utilization of fusion welding method for artistic work, calling for the creation of an artistic technique and expressing characteristics of fusion welding. Kz (11c)

First All-Welded 80,000 Barrel Tank. H. C. Boardman. *Industry & Welding,* Vol. 4, Oct. 1932, pages 24-27. Constructive details and method of welding of a spheroid tank is described in detail. Ha (11c)

Welding Longitudinal Seams of Shell Plating. Leon C. Bibber. *Engineering,* Vol. 135, Jan. 27, 1933, page 111. Abstract of paper read before the American Society of Naval Architects and Marine Engineers. LFM (11c)

Review of Experience of a Public Utility in Welding Plates and Structural Shapes. G. F. Allen. *Welding Engineer,* Vol. 18, Apr. 1933, pages 10-12. Welding was used in the construction of steel switch cells, coal cars and to replace cast parts. Labor and material saving is pointed out. Ha (11c)

Chrome Nickel Steel Riser Cutting. R. B. Aitchison. *Journal American Welding Society,* Vol. 12, Feb. 1933, pages 17-18; *Welding Journal,* Vol. 30, Jan. 1933, pages 20-24. Paper read before 33rd Annual Meeting International Acetylene Association, Philadelphia, Pa., Nov. 1932. Describes procedure for cutting 18-8 risers with ordinary oxy-acetylene cutting torch. TEJ (11c)

Structure of Welded Tubes Made of Steel Strips. J. S. Adelson. *Metal Progress,* Vol. 22, Nov. 1932, pages 37-41. The mechanics of various welding methods and their effects on the microstructure of the joints is described. The Johnston process of electric resistance, edge surface weld performed with pressure at 50 ft./min. under a stream of water avoids the overheating and change in carbon content at the center of the weld found in other methods. Assembled microphotographs show the structure from unchanged metal through the joint. The joints are somewhat harder and of higher tensile strength, but have fair ductility and can be severely worked hot or cold without fracture. WLC (11c)

Welding Heavy Engine Castings. Orville Adams. *Welder,* Vol. 4, Mar. 1933, pages 11-14. Correct preheating, careful welding procedure, proper annealing and cooling are essential for success in welding large iron castings. The author gives the proper procedure for oxy-acetylene welding. TEJ (11c)

Cutting Down and Re-erecting Welded Storage Tanks. Orville Adams. *Welder,* Vol. 4, Nov. 1932, pages 22-23. Cutting down of welded tanks of 10,000 barrels capacity and their re-erection at another location is described in detail. The saving over an entirely new tank was $1600. Ha (11c)

Welding Time for Various Types of Welds. (Schweisszeiten für verschiedene Arten der Schweissnähte.) *Zeitschrift für Schweisstechnik,* Vol. 23, Jan. 1933, pages 21-22. Gives table showing time required for various types of welds on sheets varying from 6 to 15 mm. in thickness. RRS (11c)

Autogenous Welding of Rail Joints in Holland. (Autogene Schienenstossschweissung in Holland.) *Zeitschrift für Schweisstechnik,* Vol. 23, Jan. 1933, pages 7-8. It was at first attempted to weld the rail joints by means of the thermit process, but autogenous welding proved superior. The welding rod used was free from Ni and Mn, but contained some Mo. RRS (11c)

WORKING OF METALS & ALLOYS (12)

Melting & Refining (12a)

Purification of Molten Aluminum and Aluminum Alloys. (Die Reinigung von Schmelzflüssen aus Aluminium and Aluminiumlegierungen.) H. KALPERS. *Zeitschrift für*
1 *die gesamte Giessereipraxis,* Vol. 54, July 9, 1933, pages 285-286. After considering former methods of removing gases and oxides from such melts, the author describes the methods patented by Schmidt and Godefroid. According to Schmidt gases and oxides are removed by treating the melt with a compound of CCl_4 and an alkali-bifluoride (ammonia bifluoride). Instead of CCl_4, $MnCl_2$ or SbF_5 may be used. The efficiency of these compounds is further increased by the addition of $SiCl_4$. In purifying Zn bearing Al sand cast alloys $ZnCl_2$ may also be added. Godefroid improved the method of vacuum cleaning by mixing the metal before or during vacuum treatment with compounds that react with oxides, for instance treatment with Cl or Cl compounds. There is finally discussed the method of the Vereinigte Aluminiumwerke for removal of Ti from such melts. This is attained by
2 simultaneously treating with N, Cl or Br. GN (12a)

Melting High Test Non-Shrinking Pearlitic Iron. H. H. JUDSON. *Metal Progress,* Vol. 23, Apr. 1933, pages 20-24. Experiments which led to the present melting method at Goulds Pumps, Inc. are described. The % C and the condition in which it exists were found to be the most important factors in making high pressure castings. Steel rails, spiegel, and Si pig are melted in a 54 in. diameter cupola and tapped into a ladle. Soft Fe from another cupola is weighed and poured in the hard Fe in the proportion, 3½ tons hard to 1 ton soft Fe. The 34 in. coke bed in the hard Fe cupola prevents too high C pickup, yet is low enough to bring down hot Fe from the start. The finished Fe is held to, Si 1.40 to 1.80%, S 0.10 to 0.11%, Mn 0.85 to 1.10%, P 0.150 max., and total C 2.40 to 2.80%. Tensile
3 strength of a specific casting was 45,500 lbs./in.^{2}, shear strength 51,500 lbs./in.^{2}, Brinell 212, bursting pressure 6000 lbs./in.^{2} This high bursting pressure compares with 3500 lbs. under old melting practice. The structure, shown by 2 micrographs, is pearlitic with graphite well broken up. Shrinking is entirely absent, and large castings are poured without feeding risers. Elimination of spongy spots and gas pockets, and satisfactorily fluid Fe is ascribed to careful uniform blast volume control. The non-shrinking character of this Fe is discussed, but is still an open question to the author. WLC (12a)

Fluxes in Brass Melting. WERNER FRÖHLICH. *Metal Industry,* N. Y., Vol. 31, Mar. 1933, pages 91-92; Apr. 1933, pages 123-124. Fluxes are employed as an aid to melting, as a protection against oxidation, as an eliminator of impuri-
4 ties, and as a reducing agent. Finely divided coke, etc., with ZnO is very protective against furnace gases. Borax and boric acid are effective cleansers of oxides, including alumina, lime, and silica. The use of boric acid is increasing over borax, and is commonly mixed with sodium bicarbonate in the proportions 1:3. Desulphurizing is accomplished with a charcoal and calcined soda mixture. Glass scrap or sand-soda mixtures are cheap cover slags, the former dissolving oxides, silicates and Al. Na or K carbonates absorb S and sulphides, and reduce Fe and As, but are destructive to furnace walls by absorbing silica. Talcum and quartz are used with brass alloys rich in Pb and not borax or boric acid. Fluorspar tends to increase the absorption power of fluxes for impurities. Common salt, used with cheaper grade brasses, is a fairly good solvent for oxides, and is often used with plaster of Paris. K bisulphate and
5 charcoal is used as a reducing flux to dissolve oxides, but a few hundredths percent S is picked up by charge. Al, Si and Fe are removed by sulphates of alkali and alkali earths, as K sulphate in the flux, which oxidize these metals in preference to others. Powdered quartz and calcined soda mixtures, and also mercuric chloride are used to decompose Fe carbide in melt. A KCN—soda-sand mixture is also used to reduce the Fe content of charge. PRK (12a)

Inclusions in Large Steel Forging Ingots. (Ueber nichtmetallische Einschlüsse in schweren Schmiedestahlblöcken.) F. LATTA, E. KILLING & F. SAUERWALD. *Stahl und Eisen,* Vol. 53, Mar. 30, 1933, pages 313-326. The inclusion content of 75 large ingots (7-30 tons) of basic open-hearth plain C steel was determined by microscopic examination. No definite relation between the inclusion content and the tensile and fatigue properties was observed. Statistical studies in-
dicated that the following variables in the steel making practice tended to reduce 1
the number of larger inclusions: Faster melting, slower finishing, slower carbon drop, ore addition early in the heat preferably ¾ hour before deoxidizing, longer time between addition of ferromanganese and tap, holding longer in furnace before deoxidation, faster tapping, higher tapping temperature, longer holding in the ladle, faster pouring, smaller ingot. The paper was followed by extended discussions on sand inclusions arising from the furnace and ladle refractories and from the fluxing of refractories by manganese oxide. SE (12a)

Controlled Reactions Secure Quality Steel. R. S. MCCAFFERY. *Whiting Founder,* Vol. 1, No. 3, 1932, pages 5-6. Importance of controlling and
checking chemical reactions going on in a converter is pointed out and examples 2
of representing reactions by chemical formulas are developed. Ha (12a)

Viscosity of Acid and Basic Open Hearth Furnace Slag in Molten State. TATSUO MATSUKAWA. *Suiyokwai-shi,* Vol. 7, Nov. 25, 1932, pages 57-68. Author studied viscosity of molten slag from an acid and basic open hearth furnace, containing respectively 60% and 20% SiO_2 with rotating cylinder method. Viscosity of these slags at 1650°-1700° C. is not different from that of molten steel, but a slight decrease of temperature increases their viscosity. Acid open hearth furnace slag is far more viscous than basic. By increase of FeO in slags melting point is lowered and viscosity is decreased; while MnO makes melting point higher and viscosity lower. Melting point of fayalite (2FeO, SiO_2) and rhodonite
(MnO, SiO_2) are respectively 1360° C. and 1255° C., and that of tephroite 3
(2MnO, SiO_2) is about 1270° C. HN (12a)

Influence on Cast Iron of Slag Control in Basic Electric Furnace. (Einfluss der Schlackenführung im basischen Elektroofen auf Gusseisen.) E. PIWOWARSKY & W. HEINRICHS. *Archiv für Eisenhüttenwesen,* Vol. 6, Dec. 1932, pages 221-226. Results of tests in relation to evaluation of pipe and tensile tests permitted conclusion that O-rich slags are detrimental to refining of cast Fe at high temperatures. Unsuitable slags can even annihilate more or less advantages of overheating the melt. High quality cast Fe, like all other cast alloys, needs a careful control of slag according to the same principles as those applied to melting and refining of Fe, steel or other technically important alloys. Ha (12a)

Instantaneous Refining Reaction in Slag-Steel Emulsions. ALBERT PORTEVIN. 4
Metal Progress, Vol. 23, Feb. 1933, pages 49-50. Reports almost instantaneous refining of steel by addition of a very fluid slag melted in a separate pot. P content of 15 tons of metal was reduced from 0.45 to 0.045%, and from 0.06 to 0.01%. The reaction requires vigorous rabbling so as to produce an emulsion which increases the speed of reaction between molten metal and slag. The slow diffusion in the bath characteristic of open hearth melting which is so time consuming is avoided. These acid slags attack the lining very rapidly, but as the oxides are dissolved from the metal after a short intense mixing, damage is minimized. Some materials are added to the steel before puddling, whose oxides are less soluble than Fe. Properly killed steel is obtained without addition of Fe-Si or Al. The metal-slag system is
briefly discussed. WLC (12a) 5

Making of Special Steels. V. A. KAMENSKY. *Domez,* No. 1, 1933, pages 12-28 (In Russian). Review of steel making practice, properties of steel and economic features of steel making processes taken from published data principally of German and U. S. sources. (12a)

Dephosphorization of Basic Converter Steel in Electric Furnaces. (La déphosphoration de l'acier Thomas au four électrique.) *Journal du Four Electrique*, Vol. 42, Aug. 1933, page 281. Abstract of an article by Paul Girod describing dephosphorization process according to French Patent 348,255. Adding a slag containing 25-40% iron ore and 75-60% CaO to the stream of steel running in a ladle or charging it in the furnace before steel addition cuts P content in two.
1 Several thousand tons of steel were made by this method at Societe des Hauts Fourneaux et Acieries de la Chiers. JDG (12a)

Working up of Bell Bronze by Means of Bessemer Process. (Die Zerlegung von Glockenbronzen nach dem Bessemer Verfahren.) *Die Metallbörse*, Vol. 22, June 18, 1932, pages 770-771. Data on experiments in Russia are presented where great quantities of church bells were scrapped. The great loss of Cu in the slag was cut down by using mono- or bi-silicate slags. EF (12a)

Chemistry and Technology of Non-Ferrous Metal Slag. (Zur Chemie und Technologie der Nichteisenmetallschlacke.) *Die Metallbörse*, Vol. 23, Feb. 1, 1933, pages 129-130; Feb. 8, 1933, pages 161-162; Feb. 15, 1933, pages 194-195; Feb. 22, 1933, page 226. Gives 28 references. Present state of scien-
2 tific investigations into the constitution of slag components playing an important role in non-ferrous metallurgical processes is reviewed. EF (12a)

Casting & Solidification (12b)

Making a Large Ingot Mould. J. Roxburgh. *Foundry Trade Journal*, Vol. 48, Mar. 23, 1933, pages 206-207. Describes the making of a mold for, and method of casting, a 120-ton ingot mold. OWE (12b)

Die-cast Screw Threads. Esteban. *Machinery*, London, Vol. 41, Feb. 2, 1933, pages 529-530. One of chief advantages claimed for die-casting is total or partial elimination of machining. Considerable saving is effected if certain threaded portions can be formed in die. It is well not to attempt casting of too fine a thread, especially in Zn-base alloys, as brittleness or hot shortness of certain alloys
3 detracts from strength of a fine thread. Figures and methods employed in die design for casting screw threads are discussed. Kz (12b)

Mechanism of Piping by Shrinking. Mathematical Considerations to Problem of Piping. (Der Mechanismus der Schrumpfungslunkerung. Mathematische Betrachtungen zum Lunkerungsproblem.) F. Goederitz. *Die Giesserei*, Vol. 19, Nov. 25, 1932, pages 482-483. Recent investigations show that magnitude of piping can not be attributed to different shrinking of metals. Mathematical discussions develop an exact basis for pipes from values of specific volume and volumetric shrinking. These ideas are illustrated by practical examples. Ha (12b)

More about Zinc; a Metal You Ought to Know. L. K. Urquhart. *Factory & Industrial Management*, Vol. 85, Feb. 1933, pages 54-56. Reviews
4 die casting methods. It is now possible to produce die castings from metals with casting temperatures of from 500° to 1800° F. Zn die casting is used to replace deep drawing, stamping and machining of intricate parts. The author describes parts that may be readily prepared by die casting and gives cost data. RRS (12b)

Stainless Steel Pressure Castings. S. R. Robinson. *Foundry*, Vol. 60, Dec. 1932, pages 25, 65. Production of satisfactory pressure tight castings of stainless steel offers far more difficulties than occur in manufacture of similar castings in other metals. Principal stainless steel alloy contains 18% Cr, 8% Ni, C content usually 0.16%, sometimes 0.07%. Where corrosion resistance is to be greater, Cr is increased to 24%, Ni 12% and C under 0.16%. To obtain greatest corrosion resistance stainless steel of 24% Cr, 12% Ni and 0.16% C should be given heat treatment consisting of water quench from 2100° F. Discusses molding,
5 core making and gating in making of valve body. VSP (12b)

Gages of Value in Buying Steel Castings. F. A. Melmoth & R. L. Collier. *Mill & Factory Illustrated*, Oct. 1932, pages 45-46. The properties and requirements expected from steel castings and the facts they depend on are discussed. The shrinkage of cast steel is made up of 2 phases: shrinkage during solidification and shrinkage while cooling from solidification temperature to room temperature. Foundry practice and cooperation in designing castings between customer and foundryman is touched upon. Kz (12b)

Casting Device for Aluminum Ingots for Foil. (Giessvorrichtung für Aluminiumfolien-Gussblöcke.) H. Obermüller. *Zeitschrift für die gesamte Giessereipraxis*, Vol. 54, Mar. 19, 1933, pages 119-120. A casting device for above
6 mentioned purpose is described which is to avoid (1) splashes during pouring, (2) oxide film formed on surface from getting into interior parts of ingot, and (3) formation of pipes. GN (12b)

Time Required to Cast Dental Restorations from Molten Alloy. Wilmer Souder. *Journal American Dental Association*, Vol. 20, June 1933, pages 1010-1014. Four castings of different shapes were cast following usual dental practice except one side of the mold was replaced by quartz plate; so the flow of the gold could be photographed with a motion picture camera operated at 25 exposures/sec. The plates were U-shaped rod 2 in. long, mesioclusodistal inlay plate 22 x 18 x 1.5 mm. and plate 45 x 45 x 1.5 mm. The casting pressure was 10 lb./in.^{2} The inlay mold was filled in 1/25 sec. or less, the bar in 2/25 sec., the small flat cavity in slightly more than 2/25 sec., and the large flat cavity in 3/25 sec. No evi-
7 dence of air block or rebound of alloy due to air block was detected. OEH (12b)

Production of Gravity Die and Pressure Die Castings in Aluminum. C. Vaughan. *Metal Industry*, London, Vol. 42, Jan. 27, 1933, pages 125-128; Feb. 3, 1933, pages 150-153; Feb. 10, 1933, pages 179-180; *Machinery*, London, Vol. 41, Dec. 22, 1932, pages 337-343; Dec. 29, 1932, pages 373-376; Jan. 26, 1933, pages 499-500. Practice of die casting is fully discussed, design of dies, arrangement of runners and risers, vents, die joints, coring cooling, collapsible cores and more complicated molds are described and illustrated. As molten Al has a solvent action on all metallic materials available for mold parts the following composition was found to possess a good resistance to this action: a close grain cast iron with 1.8% Si, .095 S, 0.13 P, 0.60 Mn, 3.40% total C, 0.7%
8 combined C, 0.65% Cr and 0.25% Ni. Cores and highly stressed parts of the mold are often made of tool steel with 10% W, 2½% Cr, 0.25-0.3% C. The inner surfaces of the mold should be lightly sprayed with an insulating solution of 1 oz. sodium silicate, a handful of whitening or chalk, 1 quart of water, to protect the mold against erosion; mold should be at 200° C. when sprayed. Kz + Ha (12b)

Rolling (12c)

Modern Practice in Cold Rolling. W. Trinks. *Blast Furnace & Steel Plant*, Vol. 21, July 1933, pages 359-361. Average economical limit of thickness between hot rolling and cold rolling is 0.07 in. General practice in cold rolling on 4-high mills is to aim at a reduction of 48-58% in the first pass; 41-51% in the second pass; 34-44% in the third pass; and 27-37% in the fourth pass. These
9 reductions are possible only in mills with driven small rolls and with tension on the strip, and are based on rolling mild steel with moderate flow-hardening tendencies. Speed of cold rolling and lubrication of strip and rolls have not been standardized. Speed is limited by the heat generated in the rolling process and by the methods available for abstracting that heat. Upper limit for mills with driven rolls has been 400 ft./min. but recently speeds up to 800 ft./min. have been attained in the last pass. Single-stand mill is indicated for small tonnages, while the tandem mill is preferable for very large tonnages. MS (12c)

Rolling Mill Measurements by the Condenser Measuring Method (Walzwerksmessungen nach dem elektrischen Kondensatormessverfahren) W. Mauksch. *Maschinenbau*, Vol. 12, Jan. 5, 1933, page 21. These, in principle, represent
10 electric condensers the capacity of which is changed by deforming an elastic plate on top of the pressure box or turning a spindle at the turning force recorder which in turn turns a high frequency device. RV (12c)

Design of Merchant Mill Repeaters. H. F. McEntire. *Blast Furnace & Steel Plant*, Vol. 20, Dec. 1932, pages 887-888, 893. Illustrated description. MS (12c)

Machining (12g)

Coolant Supply for Deep-hole Boring. E. SHACKLETON. *Mechanical World & Engineering Record,* Vol. 93, Mar. 10, 1933, pages 240-241. Discussion of 3 devices for feeding cutting lubricants through a hole down the center of the bar or drill to the cutting edges of tools used for boring deep holes. Kz (12g) 1

Can Tungsten-Carbide Tools be Used Successfully on Planers? COLEMAN SELLERS, 3RD. *Machinery,* Vol. 38, June 1932, page 774. Can be used successfully but in many cases is not suitable since it is difficult to take sufficient cut and speed with shock of entering cut being too great. It is successfully used on materials too hard to be cut by high speed steel. RHP (12g)

Tungsten Carbide and Other Hard Cutting Materials. COLEMAN SELLERS. *Transactions American Society of Mechanical Engineers,* Vol. 54, Oct. 15, 1932, *Research Papers Section,* pages 225-233. Progress report of Sub-Committee on Metal Cutting Materials of A.S.M.E. reviews progress in application of W and Ta carbide tools for machining processes on various metals; it is recommended that considerably more data on performance be collected and a questionnaire is given for obtaining these data in suitable form. Ha (12g) 2

Tungsten- and Tantalum-carbide Cutting Tools. H. SHAW. *Mechanical World & Engineering Record,* Vol. 91, May 20, 1932, pages 490-494. W and Ta carbides are extremely hard crystalline materials which, when cemented in a matrix of Co or Ni respectively, form cutting tools of exceptional performance. Discussion of properties of the cutting carbides, which are now used as tips brazed to a steel shank or to a steel-piece which is in turn held in a holder. The technique of manufacturing these tools is described with special attention drawn to the design of tips. Cutting speeds and tool angles for tools used on various materials are presented in a table. Examples of tool life are given and the application of chip breakers is discussed. Dealing with the treatment of the cutting carbides, the grains and grades of wheels most suitable for various grinding operations are tabulated. An example for the application of a Widia-tipped cutter which took 1/6 the time previously required for grinding is given. Kz (12g) 3

Factors Which Affect the Machinability of Black Heart Malleable Iron. (Facteurs Influencant l'Usinabilite de la Malleable a Coeur Noir.) H. A. SCHWARTZ. *Bulletin de l'Association Technique de Fonderie,* Special Number, July 1932, pages 84-87. See *Metals & Alloys,* Vol. 2, July 1931, page 135. FR (12g)

Use of Cutting Fluids. J. D. RONEY & G. L. SUMMER. *Mechanical World & Engineering Record,* Vol. 91, Apr. 29, 1932, pages 418-419. See "Cutting Fluids and Their Applications," *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 18. Kz (12g) 4

The Economical Shaping of Tool Tips. J. B. RENNIE. *Mechanical World & Engineering Record,* Vol. 93, June 9, 1933, pages 546-547. By means of sketches it is explained how the tipped tool can effect further economies by scientific design of the shape of the tip. A new cutting alloy "Rennite" is discussed, which cuts best when red-hot up to 600° C. Kz (12g)

The Design of Drills. ARTHUR S. NEWMAN & R. S. CLAY. *Journal Scientific Instruments,* Vol. 10, Jan. 1933, pages 1-4. A discussion of the design and proper methods of sharpening the diamond-shaped, the twist, and the fluted drill. RAW (12g)

Researches on the Cutting Force VI. The Cutting Force Acting at the Planing Tool. MAKOTO OKOSHI. *Bulletin Institute of Physical & Chemical Research, Tokyo,* Vol. 12, Jan. 1933, pages 70-116. Writer holds that a full knowledge of the instantaneous changes of the cutting force are indispensable for the design of machine tools. The changes entail the vibration synchronizing with the natural period of the work, tool, tool-holder and one part or the whole body of the machine. In this report, author discusses influences of cutting speed, depth of cut, width of sample, cutting angle, clearance angle, side-rake angle and radius of curvature of the cutting edge on the instantaneous changes of the cutting force and the mean value of the cutting force acting at the planing tool. WH (12g) 5

Why Are There Several Grades of Widia Cemented-Carbide Materials? ROGER D. PROSSER. *Machinery,* Vol. 38, June 1932, pages 770-771. Different work requires different grades for best results. Gives some of grades and work for which they are best suited. RHP (12g) 6

Factors that Affect Machinability. F. R. PALMER. *Metal Progress,* Vol. 23, Apr. 1933, pages 17-24. An increasing indentation hardness causes increased abrasion of tool edges, generates heat, and increases the necessary power and tool pressure. It can be overcome by reduced speed, blunter cutting edges on the tool, and use of a cooling compound. Softer annealing helps if possible. Softness is not a machining difficulty, but the toughness that accompanies it is. Toughness is corrected by annealing harder, cold drawing, and embrittling agents like S if possible. Sharper tool angles, chip breakers or lip grooves, more coolant, and finer cuts and feeds in finishing help in machining tough material. The desired microstructure varies from shop to shop. Pro-eutectoid C in high C and alloy steels is unavoidable. Harder cutting tools must be used on these steels, but correct mill practice can prevent segregated carbides. Softer annealing helps though time consuming. Austenitic steels work harden under the cutting tool. Reduced speed, careful and steady feeds, and sharp cutting angles help in machining. Little fundamental correction in the steel is possible. The friction properties of high Cr steels cause bugs on the cutting tool in machining with consequent spoilage of the finish. It can be corrected by heat treating to a higher hardness, and S or Se additions if practicable. In machining high Cr. reduced speed, steep top rake on the tool, and stoned tool surfaces are helpful. WLC (12g) 7

Developments in Cutting Tools. High Speed Stellite, Carboloy, Alloy 548. ZAY JEFFRIES & W. P. SYKES. *Metal Progress,* Vol. 23, Feb. 1933, pages 29-35. Reviews entire field of cutting tools pointing out that "revolutionary" new cutting tools do not supersede the others, but each finds its own particular field of usefulness. In introducing Sykes' Alloy 548, he indicates its field lies between high speed and cemented W carbide. It can be cast, forged or rolled, then machined and heat treated for use. It can be sold for $4.50 a lb., hence can be made into whole tools as well as inserts. The material is not sensitive, a wide range of composition and treatment gives the desired hardness and cutting qualities. It cuts the same materials as high speed, but better as the job becomes easier. Speeds up to 350 ft./min. have been used. Alloy 548 is formed by substituting Co for some of the Fe in C-free Fe-W alloy. The properties of the Fe-W and Fe-Co systems are discussed to show the inheritances of the new alloy. Equilibrium diagrams show that class 1 elements, Cr, Si, Sn, Ti, W, Mo, and Al, restrict the γ region, while class 2 elements, Ni, Mn, Cu, Zn, Co, and C, extend it. The Fe-W equilibrium diagram is sketched to show the increasing solubility of W up to 30% at 1500° C. This % gives a Brinell of 180, which can be increased to 400 by precipitation hardening. On slow cooling from 1500°, W separates as sizeable crystals of Fe-W compound with little hardness. By quenching from 1500° and reheating at 600° or 700° C., the Fe-W compound separates from solid solution in a finely divided state with max. hardness. A graph shows the 70:30 Fe-W alloys harden best and at constant value at 700° C., which gives requisite "red hardness." The effect of substituting Co for Fe in alloys of 30% W is shown in a graph. Max. secondary hardness occurs at 25% Co. Age hardening of Co alloys takes place very rapidly at 600° C. This hardness is not quite as permanent as for Fe-W alloys, but is very resistant to extended heating at 600°. Comparison of the effect of C in tool steel with C-free alloy tool steels is noted in a hardness/time-temperature graph. Secondary hardness is less permanent with C. 5 representative microstructures of Alloy 548 with various heat treatments are given and discussed. WLC (12g) 8 9 10

Carbide Milling Profitable in Both Long and Short-Run Work. FRANK W. CURTIS. *Iron Age*, Vol. 129, May 12, 1932, pages 1060-1063. Abstract of paper read before the Metropolitan and Plainfield Sections of American Society of Mechanical Engineers. Milling is one of the most practical applications for tungsten carbide. Two distinct gains made by its use. One is longer life between grinds, the other is more output. Outstanding foe of tungsten carbide is vibration. Total cost per piece of any product, should not be the determining factor as to the use of 1 tungsten carbide. VSP (12g)

The Economic Uses of Cemented Carbide and Other High Duty Alloy Steels. J. H. GARNETT & E. W. FIELD. *Journal Institution of Production Engineers*, Vol. 12, June 1933, pages 224-266. Includes discussion. Cemented tungsten carbide is made by mixing powdered cobalt with tungsten carbide which has been pulverized in a ball mill to a grain size of 0.0001 in. This mixture is pressed in a die, sintered in a hydrogen atmosphere, ground to shape, heated for a prolonged period, and finally discharged from furnace at room temperature. Tungsten carbide tends to adhere to steel, and so molybdenum-titanium carbide, to which steel chips have little tendency to "seize," has been introduced. Stellite is a 2 cobalt-chromium-tungsten alloy which is cast in graphite molds which chill it sufficiently fast to give desired grain size. Special precautions are taken to remove dissolved gas before pouring. The construction and grinding of cutting tools tipped with these materials are described, and the relative cost of tooling with cemented carbides as against high speed steel figured out for typical operations. A number of examples of tungsten carbide practice are described and illustrated. JCC (12g)

New Alloy Cements for Hard Metal Carbides. COLIN G. FINK & G. A. MEYERSON. *Iron Age*, Vol. 130, July 7, 1932, pages 8-9, 47. Gives results of investigation to find method of reducing brittleness, with sacrifice in hardness of cobalt-tungsten carbide and similar alloys. Proper selection of cementing material is of prime importance. Details of preparation of alloys are included. Results are summarized in following table:

3

Alloy No.	Comp %		Cement	Max. Sint. Deg. C.	Rockwell	Quality
1	11.5 Co	88.5 W	Co	1500	85.5	Brittle
2	11.5 Co	88.5 W	Co	1400	85.5	Brittle
3a	5.0 Co	95.0 W	Co	1420	86.5	Brittle
3b	5.0 Co	95.0 W	Co	1520	86.7	Brittle
6	5.0 Co	95.0 W	Co	1470	87.1	Brittle
16a	5.25 Co	94.75 W	Co=W=C	1470	86.6	Very tough
16b	5.25 Co	94.75 W	Co=W=C	1500	{86.8 / 87.3}	Tough
17a	4.22 Co	1.5 Mo; 94.28 WC	Co=W=C=Mo	1450	87.0	Very tough
17b	4.22 Co	1.5 Mo; 94.28 WC	Co=W=C=Mo	1500	86.8	Very tough
19a	2.1 Co = Mo	97.9 Co=W=C	Co=Mo	1500	87.2	Very tough
19b	2.1 Co = Mo	97.9 Co=W=C	Co=Mo=Cu	1500	85.0	Very tough

4

VSP (12g)

Non-ferrous Super High-speed Cutting Alloys. *Machinery*, London, Vol. 41, 5 Mar. 16, 1933, pages 715-724. Discussion of 4 cutting alloys: (1) "Wimet" is a W-carbide-Co alloy, different grades of which are produced. For machining of steel a grade containing Ti-carbide has to be used. (2) The cutting speeds recommended with "Ardoloy" tools are presented in a table. (3) "Cutanit" is a Mo-Ti-carbide alloy with a Rockwell hardness of 83-85, its specific gravity is low and it possesses good resistance to oxidation up to 900° C. (4) "Stellite" contains 45-50% Co, 25-30% Cr, 15-20% W, and 2.5-2.75% C. Rockwell hardness varies from 60.5-61.5. The capabilities of a new Stellite are summarized in a table. The balance of the article deals with the design of turning and planning tools and the manner in which chips may be produced in a form convenient for disposal, milling cutters, twist drills, etc. Care, maintenance of tools and the machining of glass and other non-ferrous materials is touched upon. Kz (12g)

6 **Development and Prospects of Hard Cutting Metal (Die Entwickelung und Aussichten der Hartmetalle)** KARL BECKER. *Werkzeugmaschine*, Vol. 37, June 30, 1933, pages 231-232. The development of efficient tools and machine tools is closely related to that of hard metals. A survey is given on the present situation in the hard metal market and its prospects in the near future. Composition, production and use of a few cast and sintered hard metal alloys are discussed. Author points out that it does not seem advisable to further increase the cutting properties of such tools unless machine tools are made better. An efficient utilization of the cutting properties is possible only by especially constructed large machine tools, the development of which is handicapped under present economic conditions. GN (12g)

7 **Precision Boring with Diamond and Cemented-Carbide Tools.** *Machinery*, Vol. 38, July 1932, pages 823-825. General article on uses and methods. RHP (12g)

The Use of New Cutting Alloys in Twist Drill Production. *Machinery*, London, Vol. 40, May 26, 1932, page 232. High-speed steel drills are compared with W-carbide and stellite drills in their efficiency on various materials. W-carbide drills turned out best except with reference to ferrous alloys. To give them a superiority also for working ferrous alloys, changes in drill design and improving in drilling machines will be necessary. Kz (12g)

New Piston Material Cut by Carbide Tools. *Machinery*, Vol. 39, Sept. 1932, 8 pages 10-11. Pistons made from Lo-Ex or Alcoa 132 aluminum alloy are machined with tungsten carbide in the plant of the Hudson Motor Car Co. The final operation on the side walls and the boring of the wrist pin holes are 2 exceptions. These are done with diamond tools. Brinell hardness of these alloys varies from 90 to 130. Discusses tool life. RHP (12g)

Long Life of Tungsten-Carbide Tools in Machining Automobile Parts. *Machinery*, N. Y., Vol. 39, Dec. 1932, pages 247-248. Tools formerly used in chamfering the bottom of the bores of cast iron cylinder blocks produced only 100 pieces per grind, with a total life of 34,000 pieces, and cost of each tool $6. Tungsten carbide tools for the same operation produce 5000 pieces per grind, total life of 264,000 pieces, and cost per tool $18. Each time a tungsten carbide tool is worn out a tool cost saving of $27 has been effected. Presents similar information regarding several other operations. RHP (12g)

Carbide Tooling on Existing Equipment. WM. CALKINS. *American Machinist*, 9 Vol. 76, Nov. 23, 1932, pages 1158-1160. Advantages of these tools over others in speeding up production are briefly explained and a few specific examples described. Ha (12g)

Free-Cutting Brass: Machinability of the Various Alloys. D. K. CRAMPTON & H. P. CROFT. *Metal Progress*, Vol. 23, Jan. 1933, pages 31-32, 62. Abstract of a manuscript for the revised National Metals Handbook. A table of feeds for various tools or operations on free-turning brass rod is given. Physical properties of 22 compositions of brass and bronze rods graded for relative machinability, cold heading and bending properties are given in another table. Drill temper is compared to free-turning brass rod as 100. Machining practice on this class of work is discussed. Effects of the constituents and impurities are described. 10 WLC (12g)

Tungsten Carbide (Wolfram Karbid) *Zeitschrift für Flugtechnik und Motorluftschiffahrt*, Vol. 23, Dec. 23, 1932, page 737. Particulars on machining properties of various tungsten carbide tools on different materials are summarized. Kz (12g)

Drawing & Stamping (12h)

Diamonds for Drawing of Tungsten Wire. (Diamanten zum Ziehen von Wolframdraht.) *Die Werkzeugmaschine*, Vol. 36, Dec. 15, 1932, pages 441-442. Discussion of preparation of diamond dies as used in incandescent lamp industry for drawing tungsten filaments. GN (12h)

Economy, Speed are Features of Tube Reducing Unit. *Steel*, Vol. 90, Apr. 25, 1932, pages 26-27. Description of new seamless tube reducing machine in which tension methods are discarded and tubes reduced by compression. Many specific advantages, economies and simplifications are claimed for this process. JN (12h)

Lubricants Used in Deep Drawing of Sheet Steel. MAURICE RESWICK. *Transactions American Society for Steel Treating*, Vol. 21, Feb. 1933, pages 181-192. See "Lubricants for Deep Drawing," *Metals & Alloys*, Vol. 3, Jan. 1932, page MA 20. WLC (12h)

Thin Strip Steel for Deep Drawing. H. T. MORTON & I. A. RUMMLER. *Transactions American Society for Steel Treating*, Vol. 21, Feb. 1933, pages 97-108. See *Metals & Alloys*, Vol. 3, Oct. 1932, page MA 306. WLC (12h)

Comparison of Sheet and Strip Steels for Difficult Stampings. EDWARD S. LAWRENCE. *Transactions American Society for Steel Treating*, Vol. 21, Feb. 1933, pages 119-138. See *Metals & Alloys*, Vol. 3, May 1932, page MA 138. WLC (12h)

Gas in the Wire Drawing Industry. Experience at Halifax. J. BRADBURY. *Gas Journal*, Vol. 201, Jan. 25, 1933, pages 199-201; discussion, Feb. 8, 1933, pages 263-264. Describes one process by which ends of rods are reduced to a diameter which will allow them to be passed through the die. Furnace in which wire is pointed is described in detail. Gas is used to anneal the wire. Where high tensile wires are used and the hardening effects of cold working are utilized, they are subjected to a different treatment known as "painting," about which little information is available, except that it is continuous. Tinning, galvanizing and enamelling are discussed. MAB (12h)

Wire Manufacture in the United States (Staltradstillverkning i Amerikas Förenta Stater) ERIK VON WACHENFELDT. *Jernkontorets Annaler*, Vol. 117, June 1933, pages 322-332. Summary of observations on study tour. HCD (12h)

Some Effects of the Amount and Rate of Deformation On a Low Carbon Strip Steel. JOSEPH WINLOCK & ALFONSO E. LAVERGNE. *Transactions American Society for Steel Treating*, Vol. 21, Feb. 1933, pages 109-118. Paper presented at Boston Convention, Sept. 1931. Experiments demonstrate effects of amount and rate of deformation on a low C (0.06%) strip steel. Specimens after cold-rolling were annealed at 1400° F. A second lot received an additional heat treatment just before testing to above Ac_3 point. Specimens were pulled at various rates from 2 to 252 in./min. In specimens annealed at 1400° F. and pulled at a rate exceeding 19 in./min., premature fracture occurred with low elongation. In specimens heated to 1750° F. and pulled at the same rates, no premature fracture occurred, "stretcher strain" lines formed, "widened" and "disappeared" as deformation increased. By pulling specimens annealed at 1400° F. at rate of 2 in./min. to elimination of surface lines and immediately elongating to fracture at 252 in./min., premature fracture was eliminated. Difference in level existing between portions of metal which have slipped and those which have not cause severe surface markings. By pulling specimens heated to 1400° F. at a slow rate, work strengthening took place. At a faster rate lack of time prevented this. Low C steel in the semi-plastic condition is best suited for deep drawing purposes. Includes discussion. WLC (12h)

Structural Change in Drawn Wire. R. SAXTON. *Mechanical World & Engineering Record*, Vol. 92, Aug. 5, 1932, pages 117-118. A large pearlitic grain is best suited to the wire-drawing process, and the size of the grain is controlled by suitable heat treatment. The drawing process causes the grains to assume an inclined position, and each successive draw increases this inclination until, if an angle approaching 45° is reached, the wire breaks readily and is overdrawn. A draw in the reverse direction has the effect of reducing the inclination of the grains, and improves the strength of the wire. Kz (12h)

Application of Hydraulic Presses and Piercing Machines in the Manufacture of Copper and Brass Pipes. P. A. SARUICHEV. *Tsvetnuie Metallui*, Feb. 1932, pages 204-213. Discussion of 2 methods of pipe manufacturing. BND (12h)

Mechanized Rod and Wire Drawing Trains (Mechanisierte Stabeisen- und Drahtstrassen) B. QUAST. *Stahl und Eisen*, Vol. 53, Mar. 2, 1933, page 215-218. Relatively simple means are described and illustrated for mechanizing rod and wire drawing trains; increased production was obtained. SE (12h)

Steeping and Liming in Wire Manufacture. R. SAXTON. *Mechanical World & Engineering Record*, Vol. 93, May 19, 1933, page 480. Steeping in a weak (5%) acid solution facilitates the expulsion of occluded hydrogen, removes fine particles of scale, and avoids acid brittleness. The coat which this method at first imparts to the wire is dehydrated oxide of iron. Liming protects this coat, neutralizes any remaining acid, and provides a base for the soap lubricant. Allowing easier slip during the drawing process, depth of reduction or number of phases is greater, resulting in economy in drawing costs. A good quality lime being of great importance, treatment of lime is discussed and the following analyses are given to indicate what constitutes a good and inferior lime:

	Good	Inferior
Silica	0.20%	1.50%
Alumina	0.50%	1.0 %
Oxide of Iron	0.10%	0.70%
Oxide of Lime	98.36%	20.0 %
Oxide of Magnesia	0.84%	—
Carbonate of Lime	—	74.80%
Carbonate of Magnesia	—	2.0 %

Kg (12h)

Graphical Determination of the Number of Passes and the Successive Diameters of Shells in a Cylindrical Stamping. (Détermination graphique du nombre de passes et des diamètres successifs des coquilles dans un embouti cylindrique.) R. OBLE. *Aciers Spéciaux, Métaux et Alliages*, Vol. 7, Mar. 1932, pages 102-104. The method of preparing a graph for determining the number of passes required and the successive diameters of the shells in making a cylindrical stamping is explained. GTM (12h)

Drawing Presses. (Ueber Ziehpressen.) OTTO KUEHNER. *Zeitschrift Verein deutscher Ingenieure*, Vol. 77, May 6, 1933, pages 469-474. The various types of machines used in modern drawing technique, hydraulic, electric, eccentric presses, are discussed and the recent improvements described. A heavy press of 500 tons pressure is described in detail. Ha (12h)

Principles of Lubrication in Cold Drawing Sheet Steel. H. A. MONTGOMERY. *Transactions American Society for Steel Treating*, Vol. 21, June 1933, pages 557-570. Paper presented at Buffalo Convention, Oct. 1932. 13 requirements of a lubricant for deep drawing and how they are obtained are described. Function of each requirement is discussed. Sulphurized lubricating mediums, introduction of Cl, CCl_4 and organic sulphates into lubricating mediums and their favorable effects except for corrosion are mentioned. Includes discussion. WLC (12h)

Deep Drawing of 18-8 Chromium Nickel Steels. (Travaux d'emboutissage sur aciers inexydables austénitiques au nickel chrome 18-8.) LECAT. *Revue du Nickel*, Vol. 3, July 1932, pages 112-114. A description of the methods of deep drawing of stainless steels. AH (12h)

Wires for Making Nails. A. MAI. *Wire & Wire Products,* Vol. 8, May 1933, pages 136-137. A description of German methods of manufacturing wire for nail making. The cheapest wire is usually employed to make manufacture of nails profitable. Grease-drawn wire is less sensitive to moisture, allows of longer storage and resists corrosion longer even in corrosion-promoting rooms. Soap-drawn wire is not advantageous for making pins as the surface becomes gray and dull under atmospheric influences. Practical points relating to the drawing and finishing processes are reviewed. Ha (12h)

Forming of Aluminum. F. V. HARTMAN & C. M. CRAIGHEAD. *Metal Stampings,* Vol. 5, May 1932, pages 313-316; June 1932, pages 407-408, 418; July 1932, pages 463-465. Discusses forming and bending properties of sheet Al and Al alloys and describes operations in blanking, bending, deep drawing, embossing, hammering and spinning. Includes table of the average mechanical properties of the alloys. MS (12h)

Lubrication for Deep Drawing. E. E. HALLS. *Machinery,* London, Vol. 42, July 20, 1933, pages 453-457. After discussing the nature of the drawing action, the function of the lubricant is dealt with. Importance of adherence and film strength of the lubricant are stressed. The corrosiveness of drawing compounds and their removal are dealt with. Lubricating media critically discussed are: refined lard and rape oils, sulphurized mineral cutting oil, soluble oils, factory prepared drawing compounds and proprietary compounds. Characteristics are presented in 5 tables. Kz (12h)

Plastic Drawing of Sheet Steel Into Shapes. E. V. CRANE. *Transactions American Society for Steel Treating,* Vol. 21, Feb. 1933, pages 155-180. See *Metals & Alloys,* Vol. 3, Jan. 1932, page MA 19. WLC (12h)

"De Dudzeele" Process and Its Use for Cold Working of Nickel Steels and Nickel Alloys. (Application du procédé "de Dudzeele" au travail à froid des aciers ou alliages renfermant du nickel.) A. DUMONT. *Revue du Nickel,* Vol. 3, July 1932, pages 116-118. A short description of the "De Dudzeele" process and of its use for wire drawing, deep drawing, forming, etc. AH (12h)

Modern Stamping. (L'Emboutissage Moderne.) P. DEVAUX. *La Revue Industrielle,* Vol. 62, Aug. 1932, pages 385-390. Descriptive article showing principles adopted in order to speed the production. Presses of the following types: Weingarten, Bliss, Grimar are described. FR (12h)

Lubrication In Drawing Sheet Steel—Annealing Strip Steel. *Iron Age,* Vol. 130, Oct. 20, 1932, page 615, adv. page 16. Session held at the convention of the American Society for Steel Treating in Buffalo. Papers read were: "Factors Influencing the Annealing of Cold-Rolled Strip Steel," by G. R. Brophy and W. L. Wyman, and "Principles of Lubrication In Cold-Drawn Sheet Steel," by H. A. Montgomery. VSP (12h)

Pickling (12i)

Removal of Pickling Fumes (Beseitigung der Beizdünste) W. FISCHER. *Oberflächentechnik,* Vol. 10, Oct. 24, 1933, pages 234-235. Fumes originating in the pickling process being more or less injurious to health must be removed from the working rooms. Hoods over the tanks and exhaustors are usually arranged, or the fumes are mixed with a spray of atomized water. Arrangements are described. Ha (12i)

Special Pickling Bath for Alloy Steel Sections. C. C. DOWNIE. *Machinery,* London, Vol. 42, July 27, 1933, page 490. By pickling in hot concentrated HCl, any slight defect is made readily visible on parts produced from special steels. To withstand the effects of the hot acid the tank has to be made from sandstone. Kz (12i)

Cold Working (12j)

On the Change in Hardness of a Plate Caused by Bending. S. KOKUBO. *Kinzoku no Kenkyu,* Japan, Oct. 1932, pages 447-456; *Science Reports Tohoku Imperial University,* Vol. 21, 1932, pages 256-267. (In English.) Change of hardness of metal plates caused by bending was measured with a Vickers hardness tester; materials used were Armco-Fe, 0.2% and 0.7% C steels, Cu, brass, Al and Mg. Results obtained were as follows and a little different from results obtained by Fink and Van Horn: Hardness of convex side of a cold-rolled specimen decreases, first rapidly and then slowly, while that of concave side always increases slightly with an increasing degree of bending of specimen. Hardness of convex side of annealed specimen decreases at first rapidly and after passing through a minimum, begins to increase gradually, with increasing degree of bending. Greater degree of work-hardening of material, the greater the increase in hardness. Change in hardness caused by elastic deformation is attributable to effect of applied stress, and that caused by a plastic deformation is explained as combined effects of stress and of work-hardening. KT (12j)

Elimination of Distortion in Cold Roll Forming. D. A. JOHNSTON. *Metal Stampings,* Vol. 5, Aug. 1932, pages 497-498, 515-516. Describes methods for determining the causes of distortion in cold roll forming machines. MS (12j)

Roll Forming and Sizing for Welded Steel Tubes. D. A. JOHNSTON. *Metal Stampings,* Vol. 5, July 1932, pages 443-446. Describes special adaptations of cold roll forming machines in the manufacture of small diameter tubular products. MS (12j)

Overcoming Distortion in Cold Roll Forming. D. A. JOHNSTON. *Metal Stampings,* Vol. 5, May 1932, pages 319-320, 351-352. Discusses characteristic distortions and deformations which tend to be produced in the roll forming of some typical shapes, and necessary allowances used in overcoming them. MS (12j)

Requirements of Steel for Cold Heading. H. W. GRAHAM. *Metal Progress,* Vol. 24, Aug. 1933, pages 22-26. Steel making practice for "rimming steel" used for this class of work is discussed. The effects of the several constituents of the steel are discussed. Unreasonably close limits on C are not necessary, wide range of Mn content can be worked, P contributes toward brittleness but much of its effect is still a mystery, S is harmful for hot work steels. Si should be low in low C steel and is very useful as a deoxidizer in higher C steels, the writer believes the harmful effects of Al have been exaggerated; except for a harmful effect upon machinability it has very desirable qualities as a deoxidizer. Wire for cold heading work is discussed. The problem of die wear is difficult to work out and requires the active cooperation of the practical man and metallurgist. Rolling and cutting of threads are discussed. WLC (12j)

Heading Properties of Brass Wire as It Varies With Composition and Temper. D. K. CRAMPTON. *Metal Progress,* Vol. 23, Mar. 1933, pages 21-24. Tests to determine the influence of variations in composition and initial temper on the ease of heading brass wire have been made. 16 alloys were used with Cu 65 to 100%, Pb 0.01 to 0.52%, and Fe 0.01 to 0.27%. Analyses, tempers and physical properties with the ratings on buckles, folds, shearing and roughness, are given in a table. Details of the preparation and testing are described. Half tones illustrate the rating standards for the 4 qualities for a reasonable amount of cold work and for reheading ability. High Pb and Fe have an adverse effect on heading qualities, though certain tempers are unaffected by Pb. Reductions to 13% have little effect, but 20% final reduction has much lower buckle rating with improved surface rating. Cu content above 64% has little effect on heading quality. At 80% improvement is noted, at 90% a decided improvement occurs. The effects of Cu, Pb, and Fe are plotted on graphs as an average of the 4 qualities in 6 tempers. Recommended practice for moderate heading is 65% Cu, less than 0.10% each of Fe and Pb with final reduction of 6 to 10% after light or intermediate anneal. For extreme heading work, 90% Cu, less than 0.05% each of Pb and Fe with optional temper is recommended. WLC (12j)

The Plastic Deformation of Metals. F. Körber. *Journal Institute of Metals,* Vol. 48, 1932, pages 317-342. The 22nd May lecture to the Institute of Metals, delivered May 11, 1932. The results of some recent studies at the Kaiser-Wilhelm-Institut für Eisenforschung are described. The conditions necessary for the occurrence of plastic deformation and the mechanism of deformation are discussed. Deformation during wire drawing was studied by engraving equally-spaced parallel lines on the flat surface of ½-round wires and drawing 2 wires through a round die. The mode of deformation was dependent on the die angle. The significance of Wever's "pole figures" is discussed. The final part of the lecture deals with the application of the findings to rolling and other metal-working processes. 36 references. JLG (12j)

Permanent Bending of Cold Steel. A. W. Knight. *Mechanical World & Engineering Record,* Vol. 92, July 1, 1932, pages 1-3. In order to discover the forces set up in rolling cold steel within the plastic range, the author used the rolls of a bending machine to make a testing apparatus. A relationship between thickness and bending radius was found. The experiments are described and their results are said to be useful in the design of plate-bending and flattening rolls. Kz (12j)

A Method of Studying Strain Hardening Suspectibility and Aging After Cold Work Deformation. Albert Sauveur & John L. Burns. *Metals & Alloys,* Vol. 4, Jan. 1933, page 6. Report some results of measuring strain hardening and aging effects following Brinell test. Brinell impression offers a means of studying strain hardening under constant load or constant strain by adjusting load to give uniform depth of impression. Amount of strain hardening is measured by Rockwell determination of hardness at bottom of Brinell impression. Results are tabulated for Armco iron and S.A.E. C steel .10 to .95% C showing susceptibility to strain hardening under constant load, constant strain and the effects of aging steels so hardened. WLC (12j)

The Formation of Localized Slip Layers in Metals. C. W. MacGregor. *Metals & Alloys,* Vol. 4, Feb. 1933, pages 19-22. Compression tests to demonstrate the effect of previous cold work on the clearness of flow layers of hard and soft Al and to show from this the magnitude of unit strain to be expected in mild steel are described. By use of conical compression plates, the angle of inclination of the cone is made equal to the friction angle of the material being tested and the "barrel effect" eliminated. Test pieces then have the same amount of cold work throughout. Rectangular test pieces were machined from pre-compressed cylinders with a hole in the center of high stress concentration. Results of tests are tabulated and illustrated with graphs and photographs by the Schleiren method. Plastic deformation in Al takes place throughout the entire wedge because it has no pronounced upper yield point and the stress at which the material yields in one portion is very soon reached in adjacent parts, while in mild steel when the upper yield point is reached the material yields in thin layers from center to the corner but as the stress is then reduced to the lower yield point, the adjacent layers are not stressed enough to become plastic. The more cold deformation originally soft and ductile material contains, the more pronounced will be the flow layers if it is again compressed to the plastic limit. A test on mild steel is diagramed showing the variation in unit shear strain from the hole to the edge. The maximum shear strain lies near the hole. WLC (12j)

The Cold Working of Cannon. B. S. Mesick, Jr. *Mechanical Engineering,* Vol. 54, Oct. 1932, pages 703-707, 710. Theory and practice of cold-working process of manufacture of cannon and thick-walled cylindrical vessels is discussed, thermodynamic principles involved in it are explained and a general description of apparatus for cold-working is given, especially of means of generating and properly applying high hydraulic pressures. Relief of internal stresses is obtained by annealing at 300° C.; this gave better results than at any other temperature between 120° and 600° C. Ha (12j)

Cold Working Properties of Wire Reduced by Pearlite. B. L. McCarthy. *Metal Progress,* Vol. 22, Dec. 1932, pages 19-23. The cold working of low C, (below 0.20%), depends on the uniform flow of each crystal. Ferrite will flow more than cementite in cold work so the wire is annealed to below the critical temperature resulting in the formation of globular cementite embedded in continuous ferrite thus giving a more even flow. 4 micrographs show this change. Higher C steels are heated above the critical and quenched to yield a fine sorbitic-pearlite which is also more easily worked. The hardening effect of cold work is discussed. WLC (12j)

Cleaning (12k)

Industrial Metal Degreasing. *Metal Industry,* N. Y., Vol. 30, Dec. 1932, pages 473-474. Abstract of bulletin of Dow Chemical Co. Most methods of metal cleaning and plating involve an initial buffing process employing acid or alkaline compounds which accelerate corrosion if imperfectly removed. Methods of metal degreasing using organic solvents are known as "Liquid Phase" and "Vapor Phase." Liquid phase degreasing does not prove to be nearly as satisfactory as vapor phase degreasing owing to fact that metal is immersed in contaminated fluid. PRK (12k)

The Cleaning of Metals. I & II. S. Wernick. *Industrial Chemist,* Vol. 8, July 1932, pages 245-246; Sept. 1932, pages 308-309. A third installment is to follow in a later issue. A discussion of trends in modern metal cleaning, alkaline cleaners, mechanism of cleaning and wetting power. RAW (12k)

Newer Methods of Metal Cleaning. C. J. S. Warrington. *Canadian Chemistry & Metallurgy,* Vol. 17, Apr. 1933, pages 77-78. Balanced cleaning powders have been developed that possess necessary wetting, emulsifying, deflocculating, anti-corrosion, and buffer alkalinity range for particular classes of grease removal and types of metals. Chlorinated hydrocarbons such as trichlorethylene, and the addition of stabilizing agents permit their use in the vapor phase degreasing plants, incorporating continuous recovery systems. Pickling inhibitors improve the efficiency, economy and comfort of pickling operations for scale or oxide removal by acids. Chief requirements of organic solvents for use in metal cleaning are: (1) solvent power, (2) freedom from high boiling residues, (3) absence of corrosive action, (4) economy in use, and (5) safety. WHB (12k)

The Cleaning of Carbon and Stainless Steel Wire. R. Saxton. *Mechanical World & Engineering Record,* Vol. 92, Dec. 23, 1932, pages 605-606. Carbon steel wire may be cleaned by either H_2SO_4 or HCl, but stainless steel requires a further immersion in HNO_3. Common salt added to the H_2SO_4 bath assists to remove scale from some stainless steels. Daily regulation of the acid baths is better than working them to exhaustion, and gives better and more uniform results. Various hints from the author's experience for improving production and quality are given. Kz (12k)

How to Secure Silver White Aluminum Pressed Parts. (Wie lassen sich silberweiss schimmernde Aluminiumpressteile für saubere Apparate erzielen?) *Brennstoff und Wärmewirtschaft,* Vol. 25, Apr. 1933, page 71. Prerequisite is sufficiently soft initial material. Usually the Al sheets are delivered too hard. Instead of annealing at 350°-375° C. for 2-4 hrs., 3 min. at 410° C. are preferable. The material is brought up to temperature as quickly as possible. A dull surface is secured by a 10% lye solution saturated with NaCl. The sheets or objects are dipped into the hot pickling solution for 20 sec., washed carefully and brushed and then pickled again, etc. until gas is liberated. After thorough cleaning, the material is dried in saw dust. The silver coating is not lost in succeeding drawing operations. If the Al object contains Cu, the surface appears black and dipping into HNO_3 is required. Clean surfaces are also obtained by pickling in diluted HF (1 part HF : 500 parts of H_2O). Lubrication means for succeeding pressing operations are not required. Vaseline or paraffin can be employed. EF (12k)

Rust Removal and Grounding of Boilers. (Entrosten und Grundieren von Dampfkesseln.) *Die Wärme,* Vol. 56, Mar. 11, 1933, pages 158-159. Manual, chemical and sand blast removal of rust and grounding technique with red lead are discussed. EF (12k)

Polishing & Grinding (12l)

New Polishing Method. (Eine neue Politur.) *Deutsche Goldschmiedezeitung,* Vol. 35, Dec. 17, 1932, page 520. Brief description of new grinding method for jewellery in which the finish polish is replaced by grinding method described. Diamond dust is used on finishing wheel. Fineness and uniform grain of diamond dust are of importance. Method is applicable to all metals. GN (12l)

Grinding of Rolls for Rolling Mills. H. J. Wills. *Iron Age,* Vol. 128, Dec. 31, 1931, pages 1683-1685, 1726. See "Steel Mill Roll Finishing," *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 20. VSP (12l)

Polishing of Silver Knives, Forks and Spoons. (Wie silberne Bestecke poliert werden.) *Deutsche Goldschmiedezeitung,* Vol. 35, Nov. 5, 1932, pages 444-445. Discusses some important points to be observed in polishing such articles. Grinding, pre-polishing and finish polishing by various methods are considered. Highest polishes are obtained in polishing with polishing steel or blood-stones. Preparation of polishing steels and blood stones are described. GN (12l)

Affinity and Cutting Properties. (Affinität und Schneidbarkeit.) W. Guertler. *Zeitschrift für Metallkunde,* Vol. 24, Sept. 1932, pages 229-230. Includes discussion. Paper before Deutsche Gesellschaft für Metallkunde, June 26, 1932. It is pointed out that rubbing materials upon one another, or machining one material by another, brings atoms in each within atomic distances permitting play of interatomic forces. When the 2 materials are constituted of elements or compounds possessing a mutual chemical affinity, chemical compounds should form. This has been shown to be the case: when metals are ground on S or P, sulphides and phosphides are formed (Cu and Ag sulphides, Fe phosphide); Mg and Pb form compound Mg_2Pb. RFM (12l)

Precision Grinding. R. Whibley. *Journal Institution of Production Engineers,* Vol. 12, Apr. 1933, pages 164-174. Accurate work can only be produced by the use of a wheel which really grinds. Polishing and lapping methods usually destroy accuracy. The advantages of hydraulically operated movements in grinding machines, the construction of wheel spindles and bearings, and the applications of centerless and surface grinding are discussed and British, American, and German practice briefly compared. JCC (12l)

Eliminating Cold-Working Strains in Drawing Rustless Steels. C. C. Snyder. *Iron Age,* Vol. 130, Aug. 4, 1932, pages 180-181; *Mechanical World & Engineering Record,* Vol. 92, Sept. 28, 1932, pages 293-294. To eliminate cold working strains and breakage it is necessary to anneal 18-8 rustless steels after they are severely cold worked. For shallow drawn parts the annealing treatment is not necessary. All metals harden to a certain extent when cold worked, but 18-8, because it is an austenite type, exhibits this tendency to a marked degree. Includes tables comparing 18-8, 18% Cr-Fe and 0.30% C steel and the effect of reduction on 18-8 round. Kz + VSP (12l)

New Small Precision Round-Grinding Machine. (Eine neue kleine Genauigkeits-Rundschleifmaschine.) R. Leonhardt. *Feinmechanik und Präzision,* Vol. 41, May 1, 1933, pages 76-78. Describes a grinding wheel for small and smallest parts in the manufacture of watches, etc. of 0.5-30 mm. diameter and 200 mm. length with an accuracy of 0.001 mm. The grinding disc has 150 mm. diameter and makes 4200 r.p.m. Several examples of application are illustrated. Ha (12l)

Modern Lapping and Grinding Processes. Hy. Mantell. *Journal Institution of Production Engineers,* Vol. 12, Apr. 1933, pages 152-163. Modern grinding and lapping processes are definite metal-removing agencies, able in some circumstances to compete with older machining methods, besides being final means of obtaining precision. Centerless grinding is quickest in operation, and is finding increasing applications. JCC (12l)

Polish on Metals. J. T. Randall & H. P. Rooksby. *Nature,* Vol. 129, Feb. 20, 1932, pages 280-281; F. Kirchner. Apr. 9, 1932, page 545. Polish on metals is attributed to the covering over of the surface by a layer of amorphous metal resulting from rubbing, which causes the metal to flow and then harden as a super-cooled liquid. Investigations were carried out by French (*Nature,* Vol. 129, page 169) on polished Cu and Ag blocks by means of G. P. Thomson's high-speed electron beam camera. On account of the observed diffraction rings it is concluded that the spacings of the Cu atoms were different from those in the crystal structure. The Cu atoms must have flowed into a random arrangement different from their orderly position in the cubic lattice. Randall and Rooksby explain the findings of French in a different way. When a metallic surface is polished the crystals break down into smaller units, causing the diffraction pattern to become diffuse. As the polishing proceeds, the interplanar spacings also alter, and a certain amount of amorphous material may be produced. Kirchner gives the following explanation of election diffraction experiments of French. A polycrystalline metal surface which is bombarded with electrons at grazing angle gives sharp diffraction rings if the surface consists of small lumps which are thin enough to allow the electrons to pass through. The lumps act as grating, and if—by polishing of the metal—they are leveled, the resolving power of the gratings is gradually diminished. The sharpness of the diffraction rings gives definite information on the degree of leveling of the surface. Results of experiments carried out by C. A. Murison, N. Stuart, and G. P. Thompson are mentioned in connection with this problem. Surfaces of Pt sputtered on glass were investigated and the results support the explanation advanced by French. Kz (12l)

"Bakelite" Bonded Grinding Wheels for Snagging. C. A. Carlson. *Foundry Trade Journal,* Vol. 48, Mar. 30, 1933, pages 223-224. A short account, with two photographs, of modern grinding machinery using high-speed bakelite bonded wheels. OWE (12l)

Measuring the Depth of Grinding Scratches. *Machinery,* London, Vol. 41, Mar. 23, 1933, pages 729-731. Since it is impossible to produce a perfectly smooth surface, means of evaluation of the condition of a surface is desirable. Besides the depth of scratches their character has to be taken into account. Article refers to the following methods of inspecting surfaces. (1) The photo-micrographic examination is a most obvious one, but appears to be impracticable for workshop tests; (2) the sound method; (3) current measurement; (4) oscillograms. (3) and (4) depend on the movement communicated to a knife edge stylus traveling in a plane parallel to the axis of the work. The average depth of scratches is 0.00006" and the width about twice that amount. To secure an accuracy of about 10% the thickness of the knife edge must not exceed 0.000004". Under conditions involved it will rapidly lose its perfection. By method (5)—i.e. by micro-sections—the work is destroyed in the process. The optical flat method (6) also entails the destruction of the work. It involves the production—on a cylindrical surface—of a tangential optical flat, the depth of which corresponds to that of the deepest scratch. Example of computing the depth of scratches by this method is given. Kz (12l)

How to Obtain Best Results in Roll Grinding. H. J. W. *Machinery,* London, Vol. 42, Apr. 6, 1933, pages 1-4; May 4, 1933, pages 124-126; June 22, 1933, pages 343-345. After dealing with the relation of surface to finish the author discusses (1) silicon-carbide wheels which produce a high luster due to the reflection of light from relatively deep and narrow grit marks and (2) aluminum-oxide wheels which generate surfaces with grit marks that are broad and shallow. Luster is not a true indication of surface perfection, and high accuracy and a fine surface can only be obtained by a cutting action. An attempt to produce a high finish with wheels that have been dulled by dressing will result only in burnishing which consists largely of the folding over of high metal ridges. Hardness, tensile strength, ductility, composition, pouring temperatures, forging procedure heat treating, etc., when varying from roll to roll, materially influence the results obtained in grinding practice. Roll-grinding machines, methods of roll mounting, and the lubrication of rests during grinding are discussed. Roll speeds for best results, the choice of coolants and importance of efficient filters are dealt with. Kz (12l)

Coloring (12m)

Coloring of Copper and Brass. (La Coloration du Cuivre et du Laiton.) M. Gossieaux. *Cuivre et Laiton,* Vol. 6, Jan. 30, 1933, pages 35-37. Several recipes for cleaning and pickling Cu and brass with H_2SO_4, or H_2SO_4 with chromic acid, or HNO_3, or a mixture of H_2SO_4 and HNO_3 are given. Cu can be colored green ("patina") by an ordinary salt solution of 25 g./l. H_2O, which is repeatedly applied to surface until the desired color is obtained; the same can be obtained by a solution of 1 lb. of ammonium chloride in about 20 l. H_2O. With following solution: H_2O (70° C) 5 l., potassium sulphide 4 to 8 g., ammonia (26%) 10 drops, metal assumes successively tints brown-bronze, red-blue, black-black; treatment is stopped when desired tone is obtained. Blue or black on brass according to duration of immersion is obtained in a solution of 5 l. H_2O (80° C.), sodium hyposulphite 250 g., lead acetate 30-60 g. Brass is also made black by 68 parts of ammonia (0.91 sp. gr.) and 10 parts basic copper carbonate, in which solution the metal is vividly moved about. Exact instructions for each procedure with treatment before and after are given. Ha (12m)

Anodic Treatment and Dyeing of Aluminum Castings. N. D. Pullen. *Metal Industry,* London, Vol. 42, June 23, 1933, pages 633-636. For the anodic treatment of Al and its alloys either for protection or for dyeing, 3 groups of processes are used: Chromic acid group in Great Britain, H_2SO_4 group in America, oxalic acid group in Germany, all of which give distinctive films. Chromic acid films are more or less opaque of pearly-gray color and fairly soft when freshly formed but increasing in resistance to abrasion with age. H_2SO_4 films are transparent, practically colorless and already fairly hard when formed. Oxalic acid films are more or less transparent with a yellow tinge; the hardness varies from extremely hard brittle films to soft and flexible ones. In the preparation of material for anodic treatment all machining, polishing, etc., must be completed before treatment, the casting must be free of foreign metal inserts, especially Cu or brass, and the surfaces must be treated so that all traces of foreign matter adhering to the castings are effectively removed. Si-Al alloys (5-13% Si) give good films in all cases but are self-colored brown-black. Cu-Al alloys should be treated in chromic acid baths and H_2SO_4 only if the Cu content is not more than 5%, while with the oxalic treatment Cu up to 12% may be present. Zn-Al alloys below 8% Zn may be treated by either process, above 8% by the oxalic treatment only. Natural and colored films can be produced, the latter by addition of coloring matter, mostly organic dyestuffs. Natural films show very little change over several years, but colored films do not have such permanence in all cases. With regard to corrosion and abrasion no preference can at present be given to any of the 3 methods. Cost of treatment, factors influencing it, and the patent situation are briefly discussed. Ha (12m)

Etching and Finishing Stainless Steel. M. H. Corbin. *Industrial Finishing,* Vol. 8, Oct. 1932, pages 11-13. In etching stainless steels: the metal is polished with pumice-oil mixture, washed in gasoline, warmed to 100-120° F., and printed with an ink base. A layer of asphaltum powder is then applied which adheres to the inked surface. Baking produces the acid "resist." The plate is then etched with neutral $FeCl_3$ solution. Film and scum are removed by washing in HCl or chromic acid solution. The etching is colored after removal of the "resist." Finally, the plate is "passified" by immersion in 20% HNO_3 for 15 to 20 min. JN (12m)

The Art of Coloring Metals. *English Mechanics,* Vol. 14, June 30, 1933, pages 204-205. A genuine green patina can rapidly be formed on Cu, bronze and brass objects by repeated brushings with a solution of NH_4Cl and vinegar. Verdigris accelerates the action. The following solution acts still better: 9 drams NH_4Cl + 2¼ drams potassium bi-oxalate in 1 quart of vinegar. A patina color on brass is obtained by immersing the object in a hot mixture of 75 cc. NH_3, 75 cc. water and 10 g. potash. A bluish-green patina is produced by 500 g. water, 2.5 g. sublimate, 8.6 g. saltpeter, 5.6 g. borax, 11.3 g. Zn-oxide and 22.5 g. Cu nitrate. Brown patina is produced by brushing with a solution of 3 g. oxalic acid, 15 g. NH_4Cl and 280 cc. H_2O. Cu is colored blue-black by dipping in a hot solution of 11.25 drams of liver of sulphur in 1 quart H_2O, while a black color is produced by 2 parts of arsenious acid, 4 of conc. HCl, 1 of H_2SO_4 66°Bé and 24 of H_2O. A lustrous black on brass: prepare a saturated solution of Cu-carbonate in strong liquid ammonia, dilute with ¼ H_2O, add 30-45 grains of graphite and heat between 95-104° F. A color resembling gold on brass: dissolve 3½ drams sodium hyposulphite in 17 drams H_2O and add 5.64 drams of antimonious chloride. Boil, filter off red precipitate, wash it with vinegar and suspend it in 3 quarts of hot water, heat and add conc. soda lye. In this still hot solution dip the clean brass articles. Further recipes refer to brown to yellow, red, violet to blue on brass, blue on iron and steel, and reddish on iron and brass. WH (12m)

Possibility of Tracing Recrystallization of Silver by Staining with Iron Chloride. (Über die Möglichkeit, die Rekristallisation des Silbers durch Anfärben mit Eisenchlorid zu verfolgen.) E. Beutel & A. Kutzelnigg. *Sitzungsberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse,* Abt. II b, Vol. 141, July 7, 1932, pages 567-576. Object of this investigation was to study different behavior of metals in hard, cold-worked state on one hand and in soft, annealed state on other hand towards coloring agents. This phenomenon was anticipated on account of changes in potential due to cold work. Ag heated up to melting point takes a dirty reddish white color, whereas rolled sheets and thoroughly annealed sheets, previously cold worked, become dark brown on treatment with $FeCl_3$. Distinct differences in appearance of the rolled sheets was noticed depending on the annealing temperature. A maximum of brightness was found between 300° and 400° C. and a minimum at 600°-650° C. The relative gain in weight of the sheets in $FeCl_3$ solutions drops considerably after annealing above 500° C. Previous pickling with diluted HNO_3 affects the color produced by $FeCl_3$. A possible connection between staining phenomena on one hand and grain size and crystallographic orientation on the other hand is discussed. WH (12m)

Some Properties of Silver Chloride Films on Metallic Silver Originated by Iron Chloride. (Über einige Eigenschaften von Silberchloridschichten, die durch Einwirkung von Eisenchlorid auf Silberoberflächen gebildet wurden.) E. Beutel & A. Kutzelnigg. *Sitzungberichte der Akademie der Wissenschaften in Wien, Mathematisch-Naturwissenschaftliche Klasse,* Abt. II b, Vol. 141, July 7, 1932, pages 577-583. The color of the AgCl films on Ag are affected by exposure to (1) elevated temperatures, (2) light and (3) reducing gases. Pickling with HNO_3 isolates the chloride layers without changing their original color. An AgCl layer suffered a loss in weight of 12.8% due to a 12 hr. exposure to ultra-violet rays of a mercury quartz lamp. Base metals and alloys rapidly reduce the chloride films to metallic Ag. (See also abstract above.) WH (12m)

Sand Blasting (12n)

Efficiency in Sandblasting. *Iron & Steel of Canada,* Vol. 15, Aug. 1932, pages 96-98. By means of 4 photomicrographs a comparison is drawn between 3 types of Canadian sand and one imported sand. 4 other photomicrographs show results of sandblasting mild steel plate with these sands. Quoting from an official report of the Dept. of Mines in Ottawa, it is stated that Canada possesses sands equal to, and even superior to, sands imported. OWE (12n)

Nails Given Sand Blast Treatment. Show Increased Holding Power. *Steel,* Vol. 91, Nov. 28, 1932, page 26. The holding powers of plain nails, cement-coated nails, and nails sand blasted with various fineness of grit are compared. JN (12n)

DEFECTS (13)

The Running and Maintenance of Marine Diesel Engines. N. E. Thompson. *Institute of Marine Engineers,* Vol. 45, Jan. 1933, pages 1-8. Paper represents author's experiences with marine Diesel engines. Gray cast iron pistons developed cracks in crown and were abandoned. Experiments with cast steel were unsatisfactory because of abnormally great wear and a return to cast iron of a fine grained gray quality was made. Special attention is paid to foundry practice aiming at homogeneous castings. Service given results turned out to be more satisfactory. Rams-bottom piston rings were found best; presumably they were made from good kind of cast iron. Salt water cooled pistons were found to be in soft and spongy condition. Premature trouble with liners and jackets was due to poor material and at certain places due to fatigue failures caused by heat stresses. Serious trouble develops at bottom of jacket due to pitting and corrosion caused by lack of circulation of cooling water. Cracks in cylinder covers occur frequently near valve due to overheating. Welding and brazing gave no satisfactory results. Kz (13)

Prevention of Grain Growth in Wrought Aluminium Alloys. D. R. Tullis. *Metallurgia,* Vol. 8, Aug. 1933, pages 129-130. Forged sections from extruded billets are apt to show excessive grain growth on annealing. Several methods have been proposed for preventing grain growth, but none is effective in every case. JLG (13)

Causes of Mechanical Breakdown. L. W. Schuster. *Mechanical World & Engineering Record,* Vol. 93, June 23, 1933, pages 605-609. The effect of impurities on the strength of a machine part depends on the shape the part may assume, the stress to which it is subjected, and the size and position of the impurities. The various kinds of cracks, such as creeping and duplex fractures are discussed. Kz (13)

Crankshaft Failure. L. W. Schuster. *Mechanical World & Engineering Record,* Vol. 93, June 30, 1933, pages 622-623. Failures due to oil holes and others caused by using water for cooling overheated bearings are discussed. The skin of the shaft is chilled in the latter case and the resulting contraction gives rise to severe circumferential tension, setting up surface cracks which gradually enter into the body of the metal. Kz (13)

Flakes in Nickel Chromium and Related Alloy Steels. F. Sauerwald, H. Gross & G. G. Neuendorff. *Metals & Alloys,* Vol. 4, Apr. 1933, pages 41-43. 21 references. A survey of present knowledge of flakes in steel is presented in tabular form. Flakes are the faces of cracks in steel and may be of 2 kinds, one of fine grain and the other a macroscopically coarser grain. Reasons for the appearance of flakes and methods of avoiding them are discussed. WLC (13)

Damages on Tire Surfaces Due to Rail Defects. (Oberflächenschäden an Radreifen als Folge von Schienenbeschädigungen.) Saller. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 88, Jan. 1, 1933, page 22. Besides the usually encountered "flat spots" due to the application of the brakes, slag-like accumulation of burnt Fe rolled into the tread over various lengths were discovered. Investigations into the source of trouble disclosed that these inclusions were due to rail defects of 3-10 mm. width, some tenths of a mm. to 3 mm. deep and extending from 30 cm. to several miles. The tires revealed some structural changes underneath the injured spots indicating a temperature rise to about 800° C. This is ascribed to skidding. Rail and tire were of about the same kind of steel. Compressive stresses increasing during breaking, occur between rail and tire. Since there are a priori tensile stresses in the tire due to the shrinking-on process, the compressive strain is larger in the rail resulting in a greater degree of wear. EF (13)

Non-Metallic Impurities in Steel Castings. (Les Impuretés non Métalliques dans les Moulages d'Acier.) F. Giolitti. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, May 1933, pages 167-185. Native slag particles have very little, if any, solubility in liquid steel. The seeming precipitation of these particles on cooling the steel is due to agglomeration of sub-microscopic particles from a state of emulsion in the steel. The quantity of inclusions present is not the predominant factor; the state of dispersion and distribution of the particles and possible reactions between the inclusions and the surrounding steel are also important. Native slag particles by their decarburizing action, give rise to adjacent conglomerations of ferrite. Manganese acts as an agglomerant on the emulsion of small particles in the steel. WHS (13)

Formation and Evolution of Inclusions. A. Portevin. *Metal Progress,* Vol. 23, May 1933, pages 45, 62. Various types of inclusions in steel are discussed and 3 important causes for them are stated, (1) chemical variation in the metal, (2) thermal variations in the cooling metal, and (3) solidification and the resultant change in concentrations in liquid and solid phases. WLC (13)

Suppression of Banding in S. A. E. 3100 Gear Steels. Harold L. Geiger. *Metal Progress,* Vol. 23, Jan. 1933, pages 37-40. Dendrites formed in the ingot in the S.A.E. 3100 steels tend to form bands in the microstructure when elongated by rolling or forging. Previous work on this subject is discussed. Annealed samples of alloy carburizing steels made by various methods were studied and almost invariably had ferrite banding in the core. This banding is usually due to elongation of the natural "as cast" dendrites during rolling or forging. It is usually unassociated with inclusions. Most alloy steels freeze in the form of dendrites up to several in. in length. The dendritic growth is influenced by pouring temperature, analysis, and rates of teeming and freezing. Several rolling mill reheatings and bar conversions will not break up this structure. Annealing tests at 1525 to 1750° F. failed to break up the banding. Various heat treatments were also without effect on the fundamental structure. However, quenching from above the critical after sufficient soaking time above Ac_3 retains C as martensite in an evenly distributed condition. Drawing to as high as 1200° F. can then be done without reappearance of the banded structure. Normalizing at 2100 eliminated the banding, but coarsened the grain enormously. Normalizing at 1650 with air cooling leaves the C more evenly distributed and hence more readily absorbed on reheating for quenching. This even distribution indicates only slight Ni differential in the bands and the area between the bands. WLC (13)

Detection of Defects in Boiler Plates by Thermal Means. (Ermittlung von Fehlstellen in Kesselblechen auf thermischem Wege.) E. Franke. *Die Wärme,* Vol. 56, May 20, 1933, pages 309-311. Impact tests performed on boiler material which failed in service are emphasized. A novel non-destructive test for the detection of inhomogeneities due to pipes, cracks, slag inclusions, etc., is introduced. A welding torch or similar source of heat is pointed against one wall side and the temperature course is checked by two thermocouples or thermometers at the opposite side. The thermocouples are placed in line with and at equal distances from the heat center. The paper shows how to locate defective spots in boiler plates by (a) shifting the source of heat and the temperature measuring devices successively over the whole plate and (b) by graphical means, i.e. by plotting curves which reveal the uneven heat flow. It can be concluded according to the diagrams included in the paper whether an unsound spot is due to a pipe or an inclusion. EF (13)

Causes of Defects in Valve Cocks. (Aussschussursachen bei Ventil- Durchgangshähnen.) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 11, 1933, pages 245-246. Discussion of the principal reasons of such defects, as improper composition and melting of the brass used, improper composition of the core sand and poor constructions. GN (13)

Hard Spots in Thin Walled Castings. (Harte Stellen in dünnwandigen Gussstücken.) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 11, 1933, pages 237-238. Discusses various reasons of hard spots in thin walled castings among which the composition of the charge is particularly referred to. GN (13)

HISTORICAL & BIOGRAPHICAL (15)

The Basic Steel Process in France. *Engineering,* Vol. 135, Feb. 10, 1933, pages 171-172; *Engineer,* Vol. 154, Dec. 16, 1932, page 611. Extended summary of the papers presented before a meeting held in Paris, Dec. 5, 1932, under the auspices of the Société des Ingénieurs Civils de France to celebrate the 50th anniversary of the introduction into France of the Thomas and Gilchrist process. LFM (15)

The Forges of the St. Maurice. *Iron & Steel of Canada,* Vol. 15, Nov. 1932, pages 133-136. History of this celebrated institution, founded in 1730. OWE (15)

Evolution of Materials Used for Steel Bridge Construction. (De ontwikkeling van het materiaal der stalen bruggen.) E. A. v. GENDEREN-STORT. *Polytechnisch Weekblad,* Vol. 26, Mar. 31, 1932, pages 197-201. Use of steel for bridge construction is historically traced back as far as 1617. Substantial advance during 18th century is emphasized. Employment of Bessemer steel for bridges on a large scale in second half of last century is shown at the hand of various more prominent accomplishments. Evolution of plain C and low alloy steels (open hearth) and the latest high grade structural steels are considered at length. WH (15)

Address of Welcome to the Iron & Steel Institute. R. A. HADFIELD. 2nd Edition. Chapman & Hall, London, 1933. Paper, 6x9¾ inches, 137 pages. Price 5s. A brochure presented to members of the British Iron & Steel Institute on their visit to Hadfield's Ltd. at the time of the Sept. 1933 meeting of the Institute in Sheffield. Contains much of the same material as several other pamphlets by Hadfield, previously issued on other occasions, considerable historical material as to metallurgical developments in Sheffield, comments on alloy steels, particularly those developed by the author or his firm, importance of the metallurgical chemist, comments on metallurgical education, especially the plans for foundry work at the University of Sheffield, and comments on metallurgical matters in general.

Hadfield thinks the worst is over and that the iron and steel industry in all countries will ultimately return to former prosperity, production of steel for the last 3 years having been insufficient to cover wastage.

At the University of Sheffield, there are 59 day students in metallurgy and around 650 in the evening extension courses for workmen, etc. in metallurgical industries. Research on cold working of steel is stressed in the University program.

One comment deserves quotation: "Research is in fact the quest for knowledge whatever the motive and if any distinction or comparison is to be drawn between 'industrial' and 'pure' research, then, on the whole, industrial or applied research is the more difficult because the end in view and often the imperative need, is a workable, satisfactory and economical solution to a specific problem." H. W. Gillett (15)-B-

The Discovery of the Elements. XIX. The Radioactive Elements. MARY ELVIRA WEEKS. *Journal of Chemical Education,* Vol. 10, Feb. 1933, pages 79-90. Historical review of discoveries of radioactive elements. 94 references. GTM (15)

The Discovery of the Elements XX. Recently Discovered Elements. MARY ELVIRA WEEKS. *Journal of Chemical Education,* Vol. 10, Mar. 1933, pages 161-170. Review of discoveries of Hafnium, Masurium, Virginium, Alabamine. 68 references. GTM (15)

The Bassenheim Furnace. H. E. WHITE. *Metals & Alloys,* Vol. 4, June 1933, pages 89-90. An historical sketch of the Bassenheim furnace in Western Pa. in the early nineteenth century. WLC (15)

Scenes Around the Early Blast Furnace. L. W. SPRING & L. E. GILMORE. *Metals & Alloys,* Vol. 4, May 1933, pages 65-68, 74. Discussion. A letter from Geo. C. Davis, Philadelphia, relates experiences in the Fe industry from 1889 on. A letter from Randolph Bolling, Norfolk Navy Yard, describes equipment used at various plants in the early 90's. A letter from A. A. Stevenson, Ardmore, Pa., gives costs and prices of Fe in 1831. WLC (15)

Scenes Around the Early Blast Furnace. III. L. W. SPRING & L. E. GILMORE. *Metals & Alloys,* Vol. 4, Mar. 1933, pages 33-36; Apr. 1933, pages 45-48. Early Chemistry and Chemists in the Iron and Steel Industries. Development of the blast furnace from the small charcoal furnace to the present day 100 foot coke furnace is traced. David Thomas' unsuccessful experiments with anthracite furnaces in Wales and his later success in the U.S.A. is described. Difficulties of transportation and mechanical operation of furnaces in 1840 is related. The first chemist was employed at a charcoal furnace near Mineville, N. Y., about 1867. Chemists and furnace men prominent in early blast furnace work are mentioned. WLC (15)

Economic Geology in Ancient Times. C. L. SAGUI. *Economic Geology,* Vol. 28, Jan.-Feb. 1933, pages 20-40. Besides other problems the article deals with furnaces built by ancient smelters and ores used. Kz (15)

Migration of Ferro-Alloy Manufacturing. FEDERICO GIOLITTI. *Metal Progress,* Vol. 23, Jan. 1933, pages 50, 52. Because of improvements in long distance transmission of power, it is no longer necessary to locate Fe-alloy factories near power sources. In Italy and France metallurgical plants have concentrated near the Alps as the cheapest source of power. The migration started a few years ago in France, more recently in Italy. The reduced cost of transporting raw materials gives a lower cost of production of 20 to 25%. The electric furnaces used at Mestre (Venice), where one plant has newly located from the Alpine district, can melt Fe-Mn practically without loss. WLC (15)

Old Charcoal Iron Furnaces in Central Pennsylvania. D. F. MCFARLAND. *Mineral Industries, Pennsylvania State College,* Vol. 2, No. 5, Feb. 1933, page 1. Historical. AHE (15)

Alan Wood Steel Company. CHARLES LONGENECKER. *Blast Furnace & Steel Plant,* Vol. 21, Jan. 1933, pages 53-60. Outlines history of the company and describes plant at Conshohocken, Pa. Comprises 3 sintering machines, 151 coke-ovens, 2 blast-furnaces, 12 open-hearth furnaces, 35-in. blooming-mill, 84-in. plate-mill, and 48-in., 56-in., 60-in., and 72-in. sheet mills. MS (15)

Improved Seamless Tubing. *Metal Progress,* Vol. 23, May 1933, pages 28-31. The history of seamless tube manufacture is recounted. New equipment for producing thin-walled tubing of improved size and surface condition is described. WLC (15)

Ancient Sand's Forge Discloses Metalworking Technique of 1740. *Steel,* Vol. 91, Aug. 8, 1932, page 30. Photographs and description of relic of early metal working plant near Birdsboro, Pa., recently purchased by Historical Society of Valley Forge. JN (15)

On the Copper Age in Ancient China. TSURUMATSU DONO. *Bulletin of the Chemical Society of Japan,* Vol. 7, Nov. 1932, pages 347-352; Vol. 8, Apr. 1933, pages 133-136. Ancient Chinese spear-heads were analyzed, and it was found that they consist mainly of Cu with certain quantities of Pb but do not contain a significant amount of Sn. The specimens are regarded as the first pure Cu implements ever discovered in China and the existence of the Cu age in China must be admitted. On account of chemical analyses and metallographical studies the author concludes that the Cu age in ancient China existed very probably closely before the bronze age. Kz (15)

Early Days of the International Nickel Company. E. A. COLLINS. *Canadian Mining & Metallurgical Bulletin* No. 255, July 1933, pages 428-452. Historical review. AHE (15)

The Age of Metals. H. CARPENTER. *Discovery,* Vol. 13, May 1932, pages 141-146. The earliest stages of primitive methods of extracting Cu and Fe are traced and the vast industrial uses nowadays of metals and alloys is discussed. Among the more recent accomplishments in the fields of metallurgy, stainless and heat resistant steels and the production of age-hardening light metal alloys are stressed. WH (15)

ECONOMIC (16)

Coal, Iron and Steel Industries of Japan. *Iron & Coal Trades Review,* Vol. 126, May 12, 1933, page 741. Trade conditions in Japan during 1932 are reviewed, statistics given on steel outputs for raw, semi-finished and finished products and figures on imports and exports, which latter rose considerably over the preceding year. Ha (16)

Can Electrochemical Industry Be Developed in Holland? (Peut on développer l'industrie eléctrochimique en Hollande?) *Journal du Four Electrique,* Vol. 42, Aug. 1933, pages 275-277. From the standpoint of production cost electrochemical industry can be developed in Holland, but its products would not have a sufficient market at home. JDG (16)

Turkish Aluminum Trade. (Der türkische Aluminiumhandel.) *Aluminium,* Vol. 15, May 15, 1933, pages 4-5. Statistics, duties and import regulations are discussed. Al sheet of 5 to 10 mm. thickness and foil and powder form the bulk of the import. Ha (16)

Platinum and Allied Metals in 1932—Advance Final Summary. H. W. DAVIS. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 218, Aug. 11, 1933, 5 pages. In 1932, Alaska produced 720 troy oz. of crude Pt, Calif. 280 oz., Oregon 74 oz., 1,074 oz. in all (885 oz. in 1931). Refiners purchased 19,043 oz. of foreign crude Pt (34,933 oz. in 1931) from Australia, Canada, Columbia, Philippine Islands and South Africa. Refiners of crude Pt, Au bullion and Cu recovered 17,616 oz. of Pt metals in 1932, a decrease of 51%, including Pd 1,252 oz., Ir 1,362 oz., Osmiridium 328 oz. Secondary Pt recovery was 32,588 oz., a decrease of 25%. AHE (16)

Mine Production of Gold, Copper, Lead and Zinc in the Eastern and Central States, 1932—Advance Summary. J. P. DUNLOP & H. M. MEYER. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 215, Aug. 9, 1933, 2 pages. Mines of the Eastern and Central States in 1932, yielded metals valued as follows: Au \$21,854, Ag \$29,052, Cu \$4,111,903, Pb \$8,381,280 and Zn \$16,008,210. In the Eastern States 21,854 oz. of Au were produced (23,827 oz. in 1931), 30,228 oz. of Ag (63,949 oz. in 1931), 10,872,200 lbs. of Cu (23,346,000 lbs. in 1931), 4,460 tons of Pb (7,974 tons in 1931) and 116,768 tons of Zn (156,697 tons in 1931); total value was \$11,095,057 (\$18,179,046 in 1931). In the Central States, output of Ag was 72,793 oz. (42,737 oz. in 1931), Cu 54,396,108 lbs. (118,059,491 lbs. in 1931), Pb 135,228 tons (181,648 tons in 1931), and Zn 98,268 tons (130,476 tons in 1931); total value was \$17,457,242 (\$34,113,936 in 1931). AHE (16)

Recovery of Metals from Secondary Sources in 1932—Advance Summary. J. P. DUNLOP. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 214, Aug. 9, 1933, 2 pages. The total value of certain nonferrous metals recovered from secondary sources (as reported to the Bureau of Mines) in 1932 was \$65,022,800, \$45,651,800 less than in 1931. Secondary Cu and brass decreased nearly 110,000 tons and more than 50% in value. AHE (16)

Cost Accounting in Steel Plant Operation (Betriebsnachrechnung und Kostenplanung im Stahlwerksbetrieb) E. CZERMAK. *Archiv für das Eisenhüttenwesen,* Vol. 6, Apr. 1933, pages 459-469. An analysis of operating costs in a steel plant is made taking into account the different overhead items, and cost of scrap, furnaces, fuel, repairs, etc.; attention is given to the effect of rate of operation on costs. Typical calculations for determining the cost of a finished unit are shown. SE (16)

Modern Cost Accounting in the Manufacture of Wire (Neuzeitliche Selbstkostenrechnung in Betrieben der Drahtverfeinerungsindustrie) E. CZERMAK, G. VEIT & K. WIEGERT. *Archiv für das Eisenhüttenwesen,* Vol. 6, Mar. 1933, pages 407-413. Sample calculations and cost sheets applying particularly to the manufacture of galvanized wire are given in considerable detail. SE (16)

Zinc in 1932. JULIAN D. CONOVER. *Metal Industry,* N. Y., Vol. 31, Feb. 1933, page 54. Mention is made of the progress achieved by the zinc industry during 1932. PRK (16)

Ferroalloys. YU. A. BOGOMOLOV. Published by the author, Moscow, 1932. Paper 5¼ x 7 inches, 214 pages. Opinions differ, of course, but most of us, opening a book entitled "Ferroalloys" expect to find in it something about this interesting metallurgical group. The author, apparently, does not share this viewpoint. Talking very eloquently about the value of research in general, singing dithyrambs to alloys as a whole and ferrous alloys in particular, justly admiring the achievements in metallurgical and related lines in the United States and the rest of the world, he says practically nothing about ferroalloys. What is worse, the facts given about them are either wrong or so general that for a technical reader they have absolutely no value. In the few cases when some details appear in the book the selection of their sources is indiscriminate in the extreme. Industrial practice of decades is opposed and rejected on the basis of a single experiment, and a not conclusive one at that. Economics and statistics of alloy production are the meat of the book and could be of a considerable interest to many, provided the data used were of a less fanciful character. The estimated production costs of non-existent plants in the years to come are often presented without a smile as legitimate comparison figures. For an outside reader the portion of the book dealing with ore deposits of Russia, with their location, capacity and state of development would be of the greatest interest. These data are not easily available and could throw much light on the possible share of this country in the world's markets, provided again that more discrimination regarding the origin of the data and less juggling of the figures were present. A single announcement in some of the daily papers of the discovery of a new deposit of something is sufficient to include it in the list of the actual resources of the country and to give its capacity. Without access to reliable foreign figures and having, probably, received an order to cheer up the boys with the possibility of the world monopoly in some metal the author performs remarkable sleight of hand with the figures.

At the same time one reads the book almost with pleasure. It is pervaded with the spirit of sincerity and good will even towards the foreign countries. The man tries his best and would most assuredly produce a very good book were he not handicapped by the lack of proper metallurgical training, the absence of undoctored figures and strict regulations of what could and what could not be said. As a pleasing exception from most of the contemporary publications the book is written in a decent language instead of atrocious *lingua franca* with which the reader is usually regaled now. (16)-B-

Ferroalloys. YU. A. BOGOMOLOV. Translated from the Russian into the Ukrainian by M. Deyneko. Published by the author, Kharkov, 1932. Paper, 6 x 8⅛ inches, 179 pages. Until 1918 Ukrainian conversation could be heard only among the peasants of southern Russia. For centuries their betters were using either Polish or Russian. The reasons for this were many, but they are out of place here, the important fact being that the vocabulary available was adjusted to the requirements of the commonest rustic life. Since the discovery 14 years ago that they have a language of their own, a considerable pressure has been exerted to prove this, an example of which is the present book.

The Russian text of the work was reviewed elsewhere in this issue, so that any further comments are hardly required. The linguistic effects achieved suggest a metallurgical book written in southern Negro dialect. The scientific terminology from the beginning to the end is the same which has been taught in the schools of the former Empire. One does not have any doubts regarding the meaning of most words though their spelling is dressed in new clothes. In the whole volume there are maybe a couple of hundred words for which the glossary, obligingly supplied at the end of the book, need be consulted. If the technicians of a country need such a translation, one can only be sorry for the country. (16)-B-

Finding New Markets. S. K. Colby. *Executive Service Bulletin of Metropolitan Life Ins. Co.*, Vol. 11, May 1933, pages 7-8. Value of research and development work to Aluminum Co. of America described by its vice-president who adduces specific examples. MFB (16)

Copper Smelting Program for 1932. A. I. But. *Tzvetnuie Metallui*, No. 3, Mar. 1932, pages 430-437. In Russian. According to the 5-year plan the total production of Cu in the U.S.S.R. for 1932 should be 90,300 tons. The author describes the actual and projected construction of roads, smelters, power plants, etc., necessary to bring about the increase in the production. BND (16)

Developments and Future Trends of the Non-Ferrous Tube Trade. Gilbert Evans. *Metallurgia*, Vol. 7, Feb. 1933, pages 111-113. In spite of wide use of rust-resisting steel tubing there will be a good demand for non-ferrous tubing. For small-size tubes base tube can be most economically made by extrusion. Larger tubes must be pierced. Discusses draw benches and concludes that those used in England are best. JLG (16)

Definite Progress in Alloy Steel Despite the Depression. Edwin F. Cone. *Iron Age*, Vol. 130, Sept. 22, 1932, pages 452-453. Statistical data of American production of alloy steels brings up to date the analysis published in Iron Age in 1929. Covers the period 1929-1931 inclusive. Gives a number of tables and graphs. VSP (16)

Chief Features of Last Year's Progress in Some Metallurgical Fields. Edwin F. Cone. *Iron Age*, Vol. 131, Jan. 5, 1933, pages 27-32, adv. sec. page 44 Reviews and interprets some of the main features of the progress during 1932 in blast furnace, open-hearth, electric and other melting operations, in heating, in new metallurgical processes and in allied fields, exclusive of materials. Some of the high lights are: Slow blowing of blast furnaces, electric melting of gray Fe, atmospheric control of heat treating furnaces, nitrided cast Fe, alloy gray Fe, Be and Se and other rare metals. VSP (16)

The Metal Industries. *Metal Industry*, N. Y., Vol. 31, Jan. 1933, pages 5-14. A series of articles on Copper, Zinc, Tin, Lead, Aluminum, Nickel and its alloys. The Precious Metals, Secondary Metals, The Brass Foundry, The Brass Rolling Mill. Jewelry Making, Plating and Finishing, giving the progress made during 1932, and mentioning prospects for 1933. PRK (16

Copper. H. F. Bain & W. G. Schneider. Copper & Brass Research Association, New York, 1933. Paper, 8½ x 11 inches, 20 pages. Condensed summary of history of copper production, tabulation of prices for the last 150 years, extras on base price, composition and properties of commercial alloys, percentage of output applied to different uses, discussion of principal uses, discussion of concentration of the industry into a few corporations with statement of connections between producers and fabricators, and a discussion of the future of copper.

Well written, full of economic data and comment, and containing considerable technical data. Users of copper products will find it very useful for reference. H. W. Gillett (16) -B-

How Economics in Percussion Tools May Be Effected. J. W. Urquhart. *Mechanical World & Engineering Record*, Vol. 92, Nov. 15, 1932, pages 512-513. Engineers' percussion hand-tools are of the first importance in engineering construction, and cost is a serious item of expenditure. Author cites case of an important railway company work-shop where economies amounting to some 90% were realized in the cost of tools by the adoption of the modern alloy-tool steels and heat treatment. Kz (16)

Tungsten and Its Occurrence. N. Venzorsky-Troitsky. *Tzvetnuie Metallui*, Feb. 1932, pages 260-268. (In Russian.) Describes uses of tungsten, its minerals, types of W ore deposits, concentration of W ores, the principal occurrences, and the world production of tungsten. BND (16)

Manganese for National Defense. C. Minot Weld, Chairman. *American Institute Mining & Metallurgical Engineers, Contribution* No. 48, 1933, 35 pages. A report of the Subcommittee on Manganese of the Committee on Industrial Preparedness of the A.I.M.E. The sources and consumption of Mn are analyzed. In order to secure an adequate supply of Mn for use in case of a National emergency it is recommended that a 700,000-ton stock of ore of ferro-grade be obtained. JLG (16)

Production of Aluminum at Arvida, Quebec. A. W. Whitaker, Jr. *Transactions Canadian Institute of Mining & Metallurgy, 1933 (in Canadian Mining & Metallurgical Bulletin 256)*, pages 408-427. General description. AHE (16)

1932 Establishes New Low Record in All Branches of Production. C. E. Wright. *Iron Age*, Vol. 131, Jan. 5, 1933, pages 2-5. Statistical survey of the iron and steel industry for the past year, shows that it was the most disastrous year in the history of the American iron and steel industry. Steel ingots and castings declined to 13,500,000 tons, or 19.5% of capacity. Pig Fe and ferromanganese to about 8,750,000 tons. Finished steel prices declined; pig Fe down to 1915 level, and scrap price was lowest for all time. VSP (16)

Second Five-Year-Plan Program of Non-Ferrous Industry in Russian Central Asia. A. V. Zdzyarsky. *Tzvetnuie Metallui*, No. 4, Apr. 1932, pages 585-590. (In Russian.) Three major projects proposed by author and accepted by State Planning Commission are to be completed during the second 5-year plan for the development of non-ferrous industry in Russian Central Asia: 1. Construction of mines and ore-concentration mills at Kara-Mazar to produce 30,000-50,000 tons of lead per year. 2. Electrolytic or electrothermic zinc plant of 75,000-100,000 tons capacity at Chirchik. 3. Cu smelting combine of 100,000 tons capacity at Almaluik. BND (16)

Chromite in 1932—Advance Summary. L. A. Smith & H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports*, No. M.M.S. 213, Aug. 8, 1933, 2 pages. In 1932, 200 long tons of chromite were mined in the U. S., compared with 762 tons in 1931. Imports were 89,143 tons, a decline of 58%. Of the imports, 17% were from Southern Rhodesia, as compared with 32% in 1931, 45% in 1930, and 52% av. for 1925-29. New Caledonia furnished 13%, Turkey 20% (increase from 1%), Greece 18%, Russia 5% and others 27%. AHE (16)

Economizing on Energy Consumption in Iron Works Operating at Low Rates (Anpassung der Energiewirtschaft der Hüttenwerke an schlechte Beschäftigung) B. v. Sothen. *Archiv für das Eisenhüttenwesen*, Vol. 6, Mar. 1933, pages 365-373. This is a sequel to the first article in vol. 6, pages 315-320. The topics dealt with are blast furnace gas, coke oven gas, producer gas, electric current, steam, airblowers, water, and compressed air. SE (16)

The Iron Year 1932 (Das Eisenjahr 1932—ein Jahr der Erfüllung und der Wende) H. J. Schneider. *Die Metallbörse*, Vol. 23, Jan. 7, 1933, pages 17-18; Jan. 14, 1933, page 53. Steel production of Germany, Saar District, Belgium, Luxembourg, France, England, U.S.A. in the first ¾ of 1932 and average production of 1929-31. The most conspicuous facts are the enormously reduced production of the U. S. (76.5%) followed by Germany (66.4%) and the advance of Russia to the leading position in Europe with 4.23 million tons between January and September 1932. Next data are presented showing the Fe consumption per capita. The U.S.A. lost the leadership in 1929 (513 kg./capita) to Great Britain (156 kg./capita) in 1932. (U.S.A. = 136 kg.). Further tables refer to export figures between 1927 and 1932 and the share of each country with respect to the total export. The balance of the paper discusses the outlook of the German iron market. EF (16)

Tax Crushing Lake Superior Iron Mining Industry. Clarence B. Randall. *Steel*, Vol. 91, July 18, 1932, pages 28-30. See "Mining Taxation in the Lake Superior District," *Metals & Alloys*, Vol. 4, July 1933, page MA 228. JN (16)

FOUNDRY PRACTICE & APPLIANCES (22)

More Economical Construction, Cheaper Casting! (Wirtschaftlicher konstruieren, billiger giessen!) R. Lehmann. VDI Verlag, Berlin, 1932. Paper, 5¾x8¼ inches, 48 pages. Price 7.50 RM. Suggestions for the design of cast machine parts for satisfactory molding and coring, for mounting of patterns, etc. Copiously illustrated. H. W. Gillett (22)-B-

Advances in Production of High-Test Gray Cast Iron and Malleable Iron (Fortschritte in der Herstellung von hochwertigem Grauguss und Temperguss) Rudolf Stotz. *Die Metallbörse*, Vol. 23, Mar. 4, 1933, pages 275-277; Mar. 11, 1933, pages 315-317. Reveals why the following more recently introduced cupolas proved to be more or less a failure: Schürmann cupola (preheated blast), Poumay furnace (spirally arranged tuyeres), furnace of the Vulkan Feuerungs A. G. (water injection) and Deutsche Werke-Spandau with Dechesne shaking forehearth, furnaces involving superheating of Fe in the fore-hearth for instance Ajax Wyatt furnace, oil fired cupolas and flame cupolas, furnaces with auxiliary coal dust firing and the revolving Brackelsberg furnace fired with powdered coal. Tendencies are reviewed aiming at improvements based on changes in melting procedures including "pearlite cast iron" according to H. Lanz-Co., Mannheim; "Sternguss" of the Krupp Co. (1.3% Mn); Emmel-Thyssen Co. (50% wrought Fe scrap) Corsalli-Gilles, Berlin (reducing the C content below 2% by excessive blast); Schütz of the Meier-Weichelt Co., Leipzig (high Si content and high cooling rate) as well as contributions of Piwowarsky, Hanemann, Klingenstein, etc., realizing the importance of super-heating cast Fe. The paper takes up in great detail how to secure high-grade cupola cast iron with above 26 kg./mm.² tensile strength without infringing on any patent, whereby special attention is paid to the analysis. The writer states that, independent of the wall thickness of the casting, good results are ascertained at 2.6-2.8% total C max., moderate Si content and melting at reasonably high temperatures. Since the correct composition of the resulting cast Fe depends to a large extent on the construction of the cupola, the effect of the height and employment of suitable tuyere types are fully discussed. Attention is focused on the size and surface area of the charge, properties of the coke, and the amount and pressure of the blast. The following table gives normal plant data on the basis of 1 sq.m. melting zone area:

Material	Output in tons/hr.	blast in m.³/min.	coke in tons/hr.	tem. on tapping in °C
ordinary cast iron	9-10	120-150	0.8-1	1320-1380
gray cast Fe with 20-30% steel scrap	8.5-9.5	130-200	0.8-1.2	1380-1450
malleable Fe with 20-30% steel scrap	8.5-9.5	150-220	0.8-1.2	1400-1450
Corsalli cast Fe with 50-95% steel scrap	?	above 220	?	?

Further tables and diagrams are presented showing the adjustment of irregularly working cupolas by employing the proper amount of blast and by adding more steel scrap to the load respectively. Data on changes in analysis, physical properties and actual savings are given. EF (22)

Classify Materials in Foundry Yards. E. H. Trick. *Foundry*, Vol. 60, June 1932, pages 28-29, 54. Describes method of material classification employed at the Alamo Iron Works, San Antonio. Texas. VSP (22)

Making Manganese Bronze. Charles Vickers. *Foundry*, Vol. 60, Oct. 1932, pages 26-27, 46. First of a series of 2 articles. Mn bronze was first patented in England in 1876 and in U. S. 2 years later. Early investigations indicate importance of hardening alloy for consistent results. Discusses the attempt of author and other investigators to discover a better way of making Mn bronze which still would conform to specifications of Parsons' or Cramp's alloy. Tests showed that Mn bronze can be made by straight alloying of metals and without using a hardening alloy, more consistent results will be obtained by using a hardener. VSP (22)

Molds for Copper Alloys (Kokillenmaterial für Kupferlegierungen) *Die Metallbörse,* Vol. 22, Oct. 15, 1932, page 1327. Ordinary gray cast iron molds for brass and bronze alloys tend to crack. The following analysis is suggested: 4% total C, 3% graphitic C, 2.0-2.25% Si, 0.6-0.9% Mn, 0.1% max. S and 0.3% max. P. Milk of lime or linseed oil is applied for covering the molds but a thin linseed oil-graphite paste is best suited withstanding 20-30 castings. EF (22)

Production of Fine Castings in Non-Metallic Permanent Molds (Die Herstellung von Feinguss in nichtmetallischen Dauerformen) ERICH BECKER. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, May 14, 1933, pages 201-202. In producing certain types of thin wall castings as casings for small switching apparatus, etc. close dimensions and sharp contours are required. Since these requirements cannot be met by molding machines and permanent metal molds are too expensive a ceramic permanent mold is used; it is described at length. The molding material is a mixture of finely ground asbestos with fire clay or quartz sand powder. Instead of such rammed molds cast ceramic molds may also be used to advantage. For larger castings a cement bearing molding material may be used. GN (22)

Design of Non-Ferrous Castings. *Foundry,* Vol. 61, May 1933, pages 16-17, 44. List of suggestions for designers and founders of non-ferrous castings compiled by the Committee on Recommended Practices, Non-ferrous Division of the American Foundrymen's Association. VSP (22)

Iron Brake Drum Lining Centrifugally Cast Into Steel Shell. *Iron Age,* Vol. 129, Feb. 18, 1932, pages 442-443. Describes the fusion into a steel foundation ring of cast Fe braking surface by centrifugal force. Foundation ring is made of strip steel (S.A.E. 1010) and is formed in double width sections in 4 operations. The 3 piece construction produces a satisfactory finished drum, permits any desired combination of ring and back thickness and simplifies manufacturing processes. VSP (22)

Casting the Ford V-8 Engine Cylinder Block. *Iron Age,* Vol. 130, Nov. 3, 1932, pages 682-685. Design of cylinder casting is based on desire to produce compact and rigid structure. New procedure in patternmaking, checking of core assemblies and accuracy in production of molds has been evolved. Mold for cylinder casting contains 43 cores. Barrel slab core forms base upon which remaining cores are placed. Fe used for casting is the regular Ford grade "A." The analysis is Si 1.80-2.10%, Mn 0.60-0.80%, C 3.20-3.50%, S 0.100 max., and P 0.25-0.32% with 15% steel scrap. VSP (22)

Foundry Working on Railways. N. L. BAILLIE. *Journal Institution of Locomotive Engineers,* Vol. 22, Nov.-Dec. 1932, pages 676-750. Includes discussion. Paper read in Buenos Aires at 2nd General Meeting of South American Centre of the Institution. The layout, working, and equipment of a railway foundry is described, with special reference to that of the Buenos Aires and Pacific Railway. Core and mould drying ovens are placed outside the building, and the white metal plant adjoins the foundry. In the ferrous foundry, by using hot blast the cupola capacity is increased 10%, fuel savings are 25%, control is more sensitive, and adequate superheat is obtained. Norwegian Bremanger iron, containing 0.7% V, is recommended for firebars and where resistance to wear is required. The installation of a Brackelsberg pulverized fuel furnace or a Detroit rocking electric furnace enables high grade castings to be produced with certainty from all-scrap charges. Crucible furnaces for non-ferrous alloys, typical compositions of railway alloys, molding and centrifugal casting machines, and molding sand characteristics are discussed. Typical defects due to improper sand conditions are illustrated. JCC (22)

Effect of Treatment of White and Gray Cast Irons in the Liquid State on Their Shrinkage and Gas Content (Influence du Traitement à l'Etat liquide des Fontes Blanches et Grises sur leur Teneur en Gaz et leur Retrait) P. BARDENHEUER & W. BOTTENBERG. *La Fonte,* Vol. 2, July 1932, pages 177-180. A summarized translation. Original appeared in *Mitteilungen Kaiser Wilhelm Institut,* 1931. See *Metals & Alloys,* Vol. 2, Dec. 1931, page 320. FR (22)

Study on a Castability Test Bar and Its Application to the Study of Alloys of the Iron-Carbon Series (Mise au Point d'une Eprouvette de Coulabilité et son Application à l'Etude du Système Fer-Carbone) R. BERGER. *La Fonderie Belge,* Vol. 2, Aug. 1932, pages 139-152. Direct measurements of viscosity of metals are useless and it is necessary to resort to an indirect measurement of castability. Description of the test bar adopted is given. This test bar is a modification of that previously used by Cury. Cross section is semi-circular instead of triangular and its area has 50 mm.² instead of 25 mm.². A core filter gives a constant speed of entrance of the metal in the spiral cavity. A vent hole is provided in the mold at the end of the spiral for improving the precision of the test bar. In the second part of his paper the author studies the FeC alloys with the help of the test bar. Conclusions reached: (1) For same pouring temperature, castability increases for C content increasing up to eutectic concentration (4.3% C) and then decreases for higher contents. (2) In the hypoeutectic range a sudden increase of the castability is noted in the neighborhood of 4% C. (3) For decreasing temperatures castability decreases but, for each temperature, the curve obtained keeps the same shape in relation to the C content. (4) The lower the pouring temperature the more marked the maximum castability corresponding to the eutectic content. FR (22)

Steel Founding in America. F. A. MELMOTH. *Foundry,* Vol. 60, June 1932, pages 16-18, 48; July 1932, pages 24-25, 53. (Final installment.) Exchange paper of the American Foundrymen's Association to the Australian Bureau of Steel Manufacturers. American foundries lean toward standardization. Care in selection of base silica sand, and careful testing methods insure sand within practical limits of constancy. Steel castings in American foundries possess an appearance and easy cleaning quality up to the highest standard of other countries. Every modification covered by heat treatment is in use ranging from normalizing, followed by a draw to liquid quenching and the necessary draw. All commonly accepted alloy steel composition are available in casting form. Gives list of alloys used in steel castings. Continuous investigation into solidification conditions has been the means of evolving better methods of gating and feeding. VSP (22)

Standards in the Foundry and Pattern Making (Normen in der Giesserei und im Modellbau) JOH. MEHRTENS. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 25, 1933, pages 271-272. The urgency of continuing the work on standardization in foundry practice is pointed out. GN (22)

Molding Sand With Cement as a Binder. Correspondence from ALBERT PORTEVIN. *Metal Progress,* Vol. 22, Sept. 1932, page 52. The use of cement as a binder in place of clay in molding sand has been introduced in France. A mixture of 0.7 to 0.9 ratio of water to cement produces strong molds that can be manipulated without box or flask supports. With inner reinforcing, they may be poured without drying or flasks. WLC (22)

Some Practical Foundry Considerations for Improving Soundness of Aluminum Castings (Quelques Considérations Pratiques de Fonderie sur l'Amélioration de la Sante des Pièces en Alliages d'Aluminium) H. J. ROWE & E. M. GINGERICH. *Bulletin de l'Association Technique de Fonderie,* Vol. 16, Aug. 1932, pages 343-352. American exchange paper at World Foundry Congress, Paris, Sept. 1932. Pinholes in Al alloy castings are due to (1) metal shrinkage during solidification, (2) occluded gases, or (3) a combination of these 2 factors. Soundness of castings depends on design and foundry technique. Foundry factors are (1) melting and pouring temperatures, (2) furnaces and fuels, (3) molding, (4) alloy constituents, (5) previous history of metal. Fluxing with chlorine gas or metallic salts, or a double melting with intermediate slow cooling, under proper foundry conditions often will improve strength and soundness of castings. 21 references. WHS (22)

FURNACES & FUELS (23)

An Electric Installation for Heat Treatment of Large Objects at Call Company (Installation de traitement thermique avec chauffage électrique pour pièces des grandes dimensions aux anciens établissements Call) E. GANE. *Génie Civil,* Vol. 101, Sept. 1932, pages 304-306. Detailed description of an electric resistance type pit furnace having 5.5 meters useful height and 1 meter useful 1
diameter. JDG (23)

Low Cost and High Quality in Electric Furnaces. H. M. WEBBER. *Metal Progress,* Vol. 23, May 1933, pages 34-37. Quality in heat treated work is discussed as it depends upon control of temperature, atmosphere, cooling and heating rates and temperature distribution in the furnace and charge. Costs are discussed as they are effected by the cost of energy used, wages of labor, fixed charges, cost of rejections and subsequent avoidable processing. The energy necessary to heat the absorbent parts of the furnace have an important bearing upon economy, especially where operation is intermittent. The success of the electric heat treating furnace in meeting the twofold problem of quality and economy is discussed.
WLC (23) 2

Low-Temperature Metal Treatment. A. J. T. EYLES. *Electrical Review,* Vol. 111, Dec. 9, 1932, page 848. Wild-Barfield electric furnace has been fitted with a centrifugal fan to assist natural convection currents. Air is drawn down the center where work is situated, and is thrown outwards at the bottom to return to the top by way of heaters at sides. Temperature variation over whole furnace is not more than 3° C. Rate of heating charge is increased but decreases as temperature increases, and at 600° C. the time required to reach this temperature with a centrifugal fan is slightly more than half that required without a fan. A combined automatic temperature controller and charge progress recorder has been developed for use with these furnaces. The recorder gives on 1 chart a record of furnace temperature and of temperature of charge. MS (23)

Economical Maintenance of Large Electric Furnaces. A. E. *Machinery,* London, 3
Vol. 42, May 4, 1933, page 127. The drawbacks of electric furnaces with Ni-Cr heating elements as fixture in parts of the furnace, the Barfield electric furnace, and the method of removing faulty hairpin shaped elements and inserting new elements while the furnace is under heat are discussed. Kz (23)

Electric Furnaces for Chemical and Metal Industries (Elektrische öfen für die chemische und Metallindustrie) M. PIRANI. *Die Chemische Fabrik,* Vol. 6, June 7, 1933, pages 242-245. Review of industrial applications for various types of electric furnaces. CEM (23)

Current Distribution and Energy Transformation in the Bath of Electric Arc Steel Furnaces (Stromverlauf und Leistungsumsatz im Bade von Lichtbogen-Elektrostahlöfen) K. A. LOHAUSEN. *Archiv für Electrotechnik,* Vol. 26, Sept. 1932, 4
pages 611-619. Current paths and electric fields in an electric 3-phase arc furnace are determined and illustrated. The energy transformed in bath is found by integration at surface of bath. A numerical example illustrates process. 5 references. Ha (23)

Electric Furnace Designed for Low Production Periods. *Steel,* Vol. 91, Nov. 21, 1932, page 32. Description of newly designed, small size, Heroult-type, 3-phase electric furnace for use in times of reduced production. This furnace offers a saving in power demand of ¼ to ½ over that of the larger unit and may be used also for special alloy heats, and general utility and experimental purposes. JN (23)

Economic Operation of Electric Arc Furnaces (La conduite rationelle des fours 5
électriques à arc) E. DECHERF. *Journal du Four Electrique,* Vol. 42, July 1933, pages 247-251; Aug. 1933, pages 282-288. Sketch of conditions to be observed for economic operation of arc furnaces and several examples of melting sheets for proper recording of data. JDG (23)

Electric Furnaces in Nickel Metallurgy (Les fours électriques dans la metallurgie du nickel) *Journal du Four Electrique,* Vol. 41, Aug. 1932, page 298. An abstract from L. Guillet paper (*Genie Civil,* June 11, 1932). At Yate plant New Caledonian ores are melted and the melt is transferred to an electric furnace in which part of the Fe in the ferro Ni produced is oxidized to give finally 92-95% Ni. JDG (23)

What the Electric Furnace Means to the Iron Founder (Was bringt der Elektroofen dem Eisengiesser?) R. GENWO. *Zeitschrift für die gesamte Giessereipraxis,* 6
Vol. 54, Aug. 20, 1933, pages 339-340. The advantages of electric furnaces are considered. The 2 methods of melting cast Fe in electric furnaces are described: (1) melting cold scrap, (2) superheating and finishing Fe melted in cupolas. Fe thus made is free of gases and oxides, and fills the mold's thinnest cross-sections. The melting procedure is outlined and data of mechanical properties are compiled. Particularly in making chilled Fe castings and malleable castings electric furnaces are advantageous. GN (23)

Electrical Equipment of Miguet-Perron Furnaces for Ferroalloys. A. M. WEINBERG & G. F. MORENKO. *Domez,* No. 4, 1933, pages 30-36. Describes electrical equipment and characteristics of arc furnaces to be installed. (23)

Importance of Electric Furnaces for German Industry (Die Bedeutung elektrischer 7
öfen für die deutsche Industrie) E. F. RUSS. *Elektrizitätswirtschaft,* Vol. 31, Sept. 30, 1932, pages 408-411. Most important types of electric furnaces are described. In all cases requiring precise thermal treatments, electric heat will be introduced. Some representative electric furnaces intended for melting and heat treating of steel and metals are described and the advantages in economical, metallurgical and technical regard are stressed. EF (23)

Electric Furnaces in the East of France (Le four électrique dans les acieries de l'Est) *Journal du Four Electrique,* Vol. 42, July 1933, pages 243-246. A description of electric arc furnaces found in plants located in Eastern part of France. JDG (23)

Electric Power Consumption in Non-Ferrous Metal Industry. N. P. ASEEV. 8
Tzvetnuie Metallui, No. 3, Mar. 1932, pages 377-386 (In Russian). Requirements of electrical energy for the production of non-ferrous metals in Russia are given in terms of kw-h. per ton of metal produced, and also total energy consumption for the entire world output of common metals in 1929. BND (23)

High-frequency Electric Furnaces. *Electrical Review,* Vol. 111, Nov. 11, 1932, page 706. Describes "Witton" partially cored high-frequency induction furnace. Path of magnetic field is through thin laminations of special alloy steel which has a magnetic conductivity several thousand times that of air path of other furnaces. This steel path is brought to a substantial nucleus of a core in a central position below the crucible and in line with the vertical axis of the inductor coil. Reduction in stray magnetic field permits use of Fe and steel throughout to encase the furnace. Lower frequency and higher voltage are used, thus reducing eddy- 9
current and hysteresis losses and improving power-factor. On a run of Ni-Cr-Mo stainless steel in a 5-cwt. furnace, 574 kwh./ton was recorded. See also Vol. 111, Sept. 9, 1932, page 352. MS (23)

The Witton High-Frequency Electric Melting Furnace. V. O. CUTTS. *Foundry Trade Journal,* Vol. 47, Dec. 8, 1932, pages 354-358, 360. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 332. OWE (23)

Induction Crucible Furnace and Its Metallurgy (Beitrag zur Kenntnis des Induktions-Tiegelofens und seiner Metallurgie) M. H. KRAEMER. *Zeitschrift Verein deutscher Ingenieure,* Vol. 76, Sept. 3, 1932, pages 866-868. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 332. Ha (23)

Theoretical and Experimental Investigations of the Coreless Induction Furnace 10
(Theoretische und experimentelle Untersuchungen über den kernlosen Induktionsofen) KURT RECHE. *Wissenschaftliche Veröffentlichungen aus dem Siemens-Konzern,* Vol. 12, Feb. 1933, pages 1-33. General theory of the furnace is developed and checked by experiments. It is shown how the dimensions must be chosen to satisfy practical conditions for satisfactory operation. Ha (23)

Coreless Induction Furnace of Four-Ton Capacity (Kernloser Induktionsofen von 4-t Fassung) *Stahl und Eisen,* Vol. 52, Aug. 4, 1932, page 765. Summary of paper by Dudley Willcox published in *Steel,* Vol. 90 (1932) No. 22, pages 23-24. See "Four-Ton Coreless Induction Furnace," *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 332. DTR (23)

Magnetic Gaps in Electric Furnace Shells (Les coupures magnétiques dans les armatures des fours électriques) Ch. Louis. *Journal du Four Electrique,* Vol. 42, May 1933, pages 172-173. Magnetic flux generated in steel shells of electric furnaces causes considerable power losses. Separating its plates with non-magnetic materials greatly reduces them. A method for using Cu connections is described. Gaps of 10 mm. are sufficient for plates 10 mm. thick. JDG (23)

Advantages of Soderberg Electrodes. Federico Giolitti. *Metal Progress,* Vol. 23, Apr. 1933, pages 47-48. Specific instances of wide and growing use of Soderberg electrodes in large furnaces are cited. Graphite electrodes can be made of smaller diameter because of higher electrical conductivity, but size is limited due to breakage in graphitizing large rods. The larger diameter of Soderberg self-baking electrodes is an advantage in melting scrap because of larger amount of surface in contact with the charge, thus avoiding localized overheating typical with graphite electrodes. The even distribution of heat shortens melting and refining operations, with consequent savings in current, refractories, electrodes and materials. Recent improvements in automatic lowering of carbons and other refinements have widened their use. The construction of 13-14 ft. rods and applications in the Al industry are being studied. WLC (23)

Oil Heating Furnaces. *Metal Industry,* London, Vol. 42, Feb. 17, 1933, pages 193-194. Construction of an oil-heated furnace is described which is employed particularly for non-ferrous metals as it produces an incandescent heat and non-oxidizing atmosphere. Temperature control by regulating fuel supply is particularly simple. Cost of fuel amounted to 2s. 3d./ton of 5½" diameter solid billets at a temperature of 850°C. Ha (23)

High Frequency Induction Furnaces. C. A. Adams, J. C. Hodge & M. H. Mackusick. *Electrical Engineering,* Vol. 53, Jan. 1934, pages 194-205. An illustrated outline of the theory of the electric induction furnace and of the application of that theory to the operating characteristics and limitations of such furnaces. Outstanding metallurgical advantages obtained from the use of induction furnaces are: freedom from contamination of the melt, the high temperatures obtainable, and the circulation of the molten charge by the electromagnetic forces within it. A very complete bibliography is appended. WHB (23)

The 3-Phase Electric Arc Furnace. Sam. Arnold. *Electrical Engineering,* Vol. 52, Dec. 1933, pages 839-843. This type of furnace is now widely used for melting and refining ferrous materials. Different types and modern developments are reviewed and examples of 3-electrode furnaces for 5000 and 10,000 kw. described. Ha (23)

Continuous Electric Furnaces (Fliessend arbeitende Elektroöfen) U. Aschmann. *Siemens-Zeitschrift,* Vol. 13, July-Aug. 1933, pages 135-141. Several types of continuous furnaces with stationary and moving hearth, pusher and rotary hearth furnaces and conveyer hearth furnaces are described. Ha (23)

A Brief Review of Modern Applications of Heat to Various Non-Ferrous Furnaces. Gilbert Evans. *Metal Industry,* London, Vol. 43, Sept. 8, 1933, pages 215-218; Sept. 15, 1933, pages 239-241. Modern British furnace installations for heating, annealing and heat treating of non-ferrous metals, designed for economy in fuel and labor for handling are described. The importance of having proper tools, as plugs, mandrels, bars and dies, for the operation is pointed out. Ha (23)

Rotating Melting Furnaces (Les Fours Rotatifs de Fusion) R. Dembreville. *Revue de Fonderie Modern,* Vol. 27, Apr. 10, 1933, pages 99-105. Construction details are given for rotary melting furnaces with oil and powdered coal used as fuel. Ha (23)

REFRACTORIES & FURNACE MATERIALS (24)

A Note on the Permeability of Refractory Materials to Gases. A. E. J. Vickers. *Journal Society of Glass Technology,* Vol. 57, June 1933, pages 93-101. The correlation between porosity and permeability for gases of refractory materials was experimentally investigated at normal temperature. In general, there is no way of telling permeability from porosity of bricks. Only in considering one particular sample of clay treated by one manufacturer a rough relation may be found. Tests at elevated temperatures seem to indicate that permeability decreases with the amount of bond and with rising temperature. This is explained by the increased kinetic energy of the gas at higher temperatures. 7 references. Ha (24)

Siemensite (Le Siemensit) Jos. Sittard. *Révue Technique Luxembourgeoise,* Vol. 25, Jan./Feb. 1933, pages 10-15. Siemensite is a new refractory especially developed for basic open-hearth furnaces consisting of Cr_2O_3 20-40%, Al_2O_3 25-45%, MgO 18-30%, other elements 8-14%, with some silica. Specific weight 3.2-3.4, heat conductivity slightly greater than magnesia, expansion between 0 and 1200° C. about 2%. Actual operation has given a wear of not more than 12 kg./ton of steel, which corresponded to about 0.92 RM (22c) per ton. Illustrations of the appearance of new and worn masonry are shown. Ha (24)

Refractories as seen from the Point of View of the Foundry (Les Réfractaires ensivagés du Point de Vue de la Fonderie) L. Louchambon. *Revue de Fonderie Moderne,* Vol. 27, May 10, 1933, pages 131-134. A general discussion of sands and materials used in the foundry for molding, cores, lining of furnaces, etc. and their particular requirements for the purposes. Ha (24)

Nozzle and Stopper Rod Assemblies. H. V. Beasley. *Blast Furnace and Steel Plant,* Vol. 21, Oct. 1933, pages 527-529; Nov. 1933, pages 581-586. Paper read before the Open-Hearth Committee, American Institute of Mining and Metallurgical Engineers, June 29, 1933. Report of a plant investigation of the relation of stopper-rod assemblies to difficulties encountered in pouring; and a laboratory investigation of the thermal distribution of graphite stopper-rod assemblies, limited to the proper relationship of stoppers, bolts, rods, and clay sleeves for obtaining good pouring. Results are shown in graphs. For obtaining best pouring practice, recommends that the ladle well should be large enough to prevent metal from chilling around the stopper. Nozzle and stopper should be designed properly for minimizing dribbles and should seat perfectly. Ladle well should be dried slowly to prevent the nozzle from cracking. Size of stopper should be proportional to the amount of steel poured. Stoppers of higher graphite content will give better service, from a refractory point of view. Male stoppers and bottom sleeves should be designed properly. A refractory and low-shrinkage mud should be used between the sleeves and the assembly dried thoroughly before use. At least 1/16"/ft. of sleeves should be allowed for sleeve expansion. Bolts for ordinary stoppers should be approximately 1¼" in diameter and made from very low-C steel, preferably 0.05% C; it is advisable to use them only once with large heats. Bolts should fit snugly in the rod and stopper and should be keyed to the rod with heavy low-C keys. Stopper should be in contact with rod end. For medium and large heats, 6" sleeves and 2" rods are preferable. Proper plug mixture is essential. Depth of undercut should be 55-60% of the diameter of the stopper. MS (24)

An Insulating Refractory for Heating Furnaces. *Iron Age,* Vol. 131, Mar. 16, 1933, page 433, adv. sec. page 10. Describes a refractory, known to the trade as "No. 80 insulating firebrick," having low thermal conductivity, low heat-storage capacity, refractoriness and light weight, developed by Babcock & Wilcox Co. Gives the properties and advantages of this new material in heating, heat-treating and other furnaces. VSP (24)

EFFECTS OF ELEMENTS ON METALS & ALLOYS (27)

Effect of Cadmium and Lead on Aluminum (Über den Einfluss von Cadmium und Blei auf die Eigenschaften des Aluminiums) *Die Metallbörse,* Vol. 22, Nov. 5, 1932, page 1423. Cd slightly raises tensile strength of Al in homogenized state. Elongation and bending properties are not affected. Due to age-hardening, tensile strength and Brinell hardness can be raised materially while elongation and bending strength are cut down accordingly. The electrical conductivity of Al is reduced but slightly due to the addition of Cd. Pb does not exert any influence upon the physical properties of Al but improves its machinability. Al-Pb alloys stand up against atmospheric corrosion in the same manner as pure Al. EF (27)

Influence of Some Impurities on the Rolling Properties of Zinc (Einfluss einiger Verunreinigungen auf die Walzeigenschaften des Zinks) *Die Metallbörse,* Vol. 22, June 4, 1932, pages 706-707. Most harmful metals are Cd and Fe besides Pb, Sn, As, Sb, Mg, S, Cu and Al. A table compiles the chemical analyses (Pb, Fe, Cd, Zn) of 6 important European Zn producers. Cd is present in solid solution. The maximum content of Cd in Zn for rolling purposes is given in literature between 0.02 and 0.3%. Fe impairs the working properties of Zn by rendering it hard and brittle. This effect is already noticeable at 0.015% Fe. Mn and Ni act similar to Fe, but are rarely present in commercial Zn brands. Pb affects the rolling properties but moderately. A tendency towards rupture prevails at 1.5% Pb. PbS is considered to induce brittleness during rolling. Sn causes fractures during rolling due to low melting Sn-Pb eutectic at the grain boundaries of Zn. Mg also forms a eutectic while As and Sb render the Zn brittle. S and C seem to exert no harmful effect. The opinions on Cu encountered in electrolytic Zn are divided. The strength of Zn seems to be raised by Al more than by Cu. EF (27)

INSTRUMENTS & CONTROLLERS (28)

New Applications for Bimetal Relays. (Neue Anwendunsgebiete für Bimetallauslöser.) A. Cohn. *AEG-Mitteilungen,* Sept. 1932, pages 302-305. Describes a few constructions and arrangements for protection of motor circuits. The bimetal elements are directly heated so as to preclude any time lag in operation due to the characteristic of the indirect heating device. Ha (28)

Measurement of Small Outputs by Thermal Instruments. (Messung kleiner Leistungen mit thermischen Messgeräten.) G. Pfestorf. *Archiv für technisches Messen,* Vol. 2, Dec. 1932, section V 3418-2, page T 6. Theory and application of a hot-wire watt meter which measures down to 10 microwatt with a mirror galvanometer. Ha (28)

EFFECT OF TEMPERATURE ON METALS & ALLOYS (29)

Manufacturing Heat-Resisting Cast Irons. *Foundry Trade Journal,* Vol. 47, Nov. 24, 1932, pages 319-321. See "The Action of Elevated Temperatures on Cast Irons," *Metals & Alloys,* Vol. 4, June 1933, page MA 196. OWE (29)

Creep at Elevated Temperatures. *Mechanical World & Engineering Record,* Vol. 92, Dec. 2, 1932, page 527. Determinations between 750° and 1100° F. for Cr-V steels containing W and Mo. Compositions, mechanical properties, and heat treatment of the alloy steels which were tested for creep are given in a table. Kz (29)

Short-time Tensile Tests on Alloys and Steels at High Temperature. *Mechanical World & Engineering Record,* Vol. 93, Mar. 31, 1933, page 314. Results of short-time tensile tests at elevated temperatures made by W. Kahlbaum and L. Jordan are discussed and given in 5 tables. Investigated are: a medium Mn steel, a series of cast Ni-Cr-Fe alloys containing about 0.50% C, 35% Cr, and 10-45% Ni; and 2 series of low alloy steels—namely, W-Cr-V and Mo-Cr-V steels, all normalized, hardened and tempered at 1200° F. Kz (29)

Physical Properties of White Bearing Metals at Various Temperatures (Mechanische Eigenschaften der Weisslagermetalle bei verschiedenen Temperaturen) *Die Metallbörse,* Vol. 22, Aug. 6, 1932, pages 1006-1007. Physical properties of white bearing metals are reviewed showing the favorable influence of Sn on Pb-Sn-Sb alloys. The Ca-Ba bearing metals on Pb-base and the Pb-Sb-Sn alloys with 3% Sn tested under actual service conditions were less wear resistant than the Sn-rich bearing metals. None of the alloys investigated yielded the best results with reference to all physical properties. The bearing metals with high Sn concentrations showed the best wear resistance and impact hardness between 20° and 200° C. but in most cases the fatigue impact resistance was lower than that of other types of white bearing alloys. EF (29)

Properties of Some Commercial Coppers at Elevated Temperatures [Die Eigenschaften einiger Handelskupfer (Rohkupfer) bei erhöhten Temperaturen] *Die Metallbörse,* Vol. 22, Oct. 15, 1932, page 1326. References on the subject are presented with emphasis on recent investigations of Bramford on dynamic tests of 5 different commercial Cu brands. No range of brittleness was found below 600° C. and the Charpy tests yielded maximum values between 200° and 340° C. Only one brand rich in As displayed inferior impact hardness up to 600° C. Ni bearing Cu withstood the highest load under alternating stress even at 560° C. and As-free Cu showed the lowest resistance. Over the whole testing range tough-poled As-free Cu was softest. The hardness of deoxidized As-free Cu rises up to 180° C. and is higher than that of any other Cu brand between 50° and 150° C. EF (29)

Bending Strength of Cu (Untersuchungen über die Biegefestigkeit des Kupfers) *Die Metallbörse,* Vol. 23, Nov. 26, 1932, page 1519. At constant temperatures bending strength of Cu rises as a straight line function up to 2.5% cuprous oxide. Effect of temperature upon bending strength curve is more pronounced than the influence of O according to Gorshkow & Hagen-Torn. Between 650° and 930° C. the bending strength of Cu might vary between 20 and 25%. A large drop is found between 930° and 1000° C. Formation of cracks in rolled Cu sheet is ascribed to temperature effects rather than to the presence of Cu_2O. EF (29)

Chemistry of High Temperatures (Die Chemie der hohen Temperaturen) *Die Metallbörse,* Vol. 22, Nov. 2, 1932, page 1407. Reviews a paper of O. Ruff at the Meeting of Deutsche Naturforscher und Ärzte, Wiesbaden, 1932, dealing with the physico-chemical phenomena of matter at elevated temperatures. Only elements of IV-VIII group of periodic system have a m.p. above 2000° C. besides oxides, nitrides, carbides and borides. The highest melting substance so far known is a mixture of 4 TaC + 1 HfC. Additions of MgO counteract cracking of Zr dioxide apparatus due to the conversion into the tetragonal modification. The allotropic transformations can be checked by X-rays. The manufacture of implements for high temperatures is discussed. Reactions in heterogeneous systems at the boundary line solid phase/gas and liquid state/gas with reference to metallurgical problems is considered. EF (29)

The Testing of Materials for High Temperature Service. William Barr. *Journal West of Scotland Iron & Steel Institute,* Vol. 40, Oct. 1932, pages 7-12. The creep test and the accelerated creep tests are critically discussed. Embrittlement experiments performed by the author show that temperature affects the impact of the notched bar impact tests. A Ni-Cr-Mo steel, a stainless iron, and mild steel were tested. 12 references. GTM (29)

An Accelerated Creep Test. W. Barr & W. E. Bardgett. *Mechanical World & Engineering Record,* Vol. 91, Mar. 11, 1932, pages 245-247. See *Metals & Alloys,* Vol. 4, June 1933, page MA 131. Kz (29)

Expansion Measurements on Aluminum Casting Alloys for Motor Pistons (Ausdehnungsmessungen an Aluminium-Gusslegierungen für Motorenkolben.) Franz Bollenrath. *Metallwirtschaft,* Vol. 12, Feb. 17, 1933, pages 85-89. Chemical composition of the 7 alloys tested was: No. 1 4% Cu, 1.5% Mg, 2% Ni, bal. Al; No. 2 10% Cu, .3% Mg, bal. Al; No. 3 15% Cu, .3% Mg, .3% Ni, bal. Al; No. 4 4.5% Cu, .7% Mg, 12% Si, 2.5% metals of Fe group, bal. Al; No. 5 1.5% Cu, 1% Ni, 20% Si, bal. Al; No. 6 1.6% Cu, .5% Mg, 20-22% Si, 4% metals of Fe group, bal. Al; No. 7 0.7% Fe, 35% Si, .3% Ti, 4% non-metallic additions, bal. Al. All of these alloys have been used for automotive or aircraft pistons. Cylindrical test bars were chill cast and placed horizontally in the dilatometer. The average rate of heating was .8° C./min. up to 520°. The bars were held at 520° for 24 hours, cooled over a 16 hour period and reheated at the same rate. Pure Al test bars were used in every case for comparison. Temperature expansion curves and curves showing the ratio of the slope of the expansion curve of the sample to the slope of the expansion curve of the Al standard are given for the 7 alloys, also photomicrographs in the cast and annealed conditions. The average and true coefficients of expansion up to 500° are given in tabular form. In most cases the rate of expansion during the first heating increases considerably above 200°, indicating growth. In the second heating this increase is much smaller and often at a higher temperature. Alloy No. 1 had the most consistent rate of expansion and was practically free from growth and sudden increase in expansion rate. No. 2 grows rapidly between 230° and 240°, reaching a coefficient of expansion of .0000365. This is caused by precipitation from the supersaturated solid solution. In the second heating the growth is very much reduced. Pistons made from this alloy should be heated to about 280° before being used. No. 3 had similar properties. No. 4 is a hypoeutectic alloy which exhibits growth and variation in rate of expansion both in the first and second heating. No. 5 is hypereutectic. Its growth takes place at higher temperatures, reaching a maximum at 310°. In the second heating this is somewhat reduced and occurs at still higher temperature, above operating temperatures. In No. 6, containing .5% Mg, the initial growth is very high, but is practically eliminated after the first heating. No. 7 has a fairly constant and exceptionally low rate of expansion. The average coefficients between 20° and 500° C. are No. 1 25.6 $\times 10^{-6}$, No. 2 25.7, No. 3 25.7, No. 4 21.7, No. 5 20.3, No. 6 19.2, No. 7 16.0. 3 references. CEM (29)

Testing of Materials for Service in High-Temperature Steam-Plant. R. W. Bailey & A. M. Roberts. *Proceedings Institution of Mechanical Engineers,* Vol. 122, Feb. 1932, pages 209-284, 298-377. See *Metals & Alloys,* Vol. 4, July 1933, page MA 237. RHP (29)

Obtaining Reliable Values for Creep of Metals at High Temperatures. H. W. Gillett & H. C. Cross. *Metals & Alloys,* Vol. 4, July 1933, pages 91-98, 104. Creep tests are discussed in the light of the Joint High Temperature Committee's Tentative Test Code for Long-time High Temperature Tensile Tests. The more rigid requirements of the Code are justified when supplying data for design as present methods of reporting creep by extrapolation are unreliable. The methods of making creep tests, source of errors, time required and methods of reporting are described in detail. A table shows the effect of furnace liners of different metals on the temperature uniformity in tests by the authors. 18 references. WLC (29)

Endurance Limit of a 0.33% Carbon Steel at Elevated Temperatures. J. W. Cuthbertson. *Iron & Coal Trades Review,* Vol. 125, Sept. 16, 1932, pages 415-417; *Engineering,* Vol. 134, Sept. 30, 1932, page 396. Abstract of paper read before the Iron & Steel Institute, Sept. 1932. See *Metals & Alloys,* Vol. 4, June 1933, page MA 196. Ha + LFM (29)

The Fatigue Resisting Properties of Light Aluminum Alloys at Elevated Temperatures. J. W. Cuthbertson. *Engineering,* Vol. 155, Mar. 17, 1933, page 267; *Engineering,* Vol. 135, Mar. 25, 1933, pages 327, 342-343. Includes discussion. Short abstract of paper read before the Institute of Metals, London, Mar. 8, 1933. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 336. LFM (29)

Calculation of Specific Heat of Solid Bodies (Zur Berechnung der spezifischen Wärme von Festkörpern) K. Honnefelder. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 21, Apr. 1933, pages 53-64. The specific heat of some solid bodies is theoretically evaluated. At reasonably low temperatures, an agreement with experimental observations was found with reference to Cu, Cd, and ZnS. In case of Zn a mean deviation of 1% was established. Moderate divergencies were noticed in case of W and Sn. With reference to "lowest temperatures," i.e. below 15-25° abs., no agreement between experimental determinations and data derived by 2 methods could be secured for W, Zn, and Cd. The theoretical values were up to 70% below the experimental mean values. There were no discrepancies in case of NaCl, KCl and CaF_2. EF (29)

Measuring Hardness at High Temperatures. J. Ferdinand Kayser. *Metal Progress,* Vol. 23, Mar. 1933, pages 50, 52. A method, developed by the author, for determining Brinell hardness at high temperature uses a small cone-shaped specimen inserted in the plunger of heat resisting metal and submitted to a 35 kg. load for 10 days in a small electric furnace. The anvil cap on which the cone rests is a 60% Ni, 20% Cr, 7.5% Al alloy. Temperature is controllable and atmosphere inert. A sketch shows the layout. The cone flattens out from pressure, time and temperature, equilibrium being reached in 100 hrs. Hardness is calculated from area of the flattened surface in mm.[2] divided into the load. Most metals above 700° C. have less than 10 Brinell. Values obtained agree with creep stress data. WLC (29)

Some Physical Properties of Wiping Solders. D. A. McLean, R. L. Peek, Jr. & E. E. Schumacher. *Journal of Rheology,* Vol. 3, Jan. 1932, pages 53-74. See *Metals & Alloys,* Vol. 3, Sept. 1932, pages MA 285. GTM (29)

Modulus of Elasticity of Steel at High Temperatures. E. Honegger. *Mechanical World & Engineering Record,* Vol. 92, Oct. 14, 1932, pages 357-358. See *Metals & Alloys,* Vol. 4, June 1933, page MA 196. Kz (29)

Bolt Embrittlement. *Engineering,* Vol. 134, July 22, 1932, page 100. Brief summary of discussion by Harley-Mason in 1932 annual memorandum to Manchester Steam Users' Association. Comments on difficulties encountered in testing the reliability of brittle bolts in service conditions. See "Embrittlement at High Temperatures," *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 336. LFM (29)

Cast Iron for High Temperature Service (Das Gusseisen für thermisch beanspruchte Teile) L. Schmid. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 25, 1933, pages 257-260. Considers the various possibilities of processing cast Fe with decreased tendency to growth. To attain a small decomposition of Fe_3C it is possible either (1) to use an Fe with such small contents of Si, P and Ni and such high contents of Mn and Cr that the carbides remain stable at higher temperatures or (2) to choose these constituents so as obtain an Fe which is already practically free from carbides. The latter type of Fe, for instance, is used in making ingot molds. Special points must be observed in making grates and other parts subjected to extremely high temperatures. Such parts should show no graphite in the areas exposed to the fire gases and be free from volume changes due to subsequent graphite disintegration. Cast irons with very low C, Si, P and S but with very high Mn contents are suggested in these cases. For parts that are subjected, in addition to thermal changes, to high mechanical loads, as for instance cylinders and cylinder heads of Diesel engines, the mechanical load is of prime consideration. For this reason cast steel is increasingly used for the highly stressed parts of Diesel engines. Tables show average chemical composition of cast Fe used at high temperatures, melting charges, etc. GN (29)

Mechanical Stresses at the Connections Between Rolled-in Tubes and Boilers (Die mechanische Beanspruchung der Rohreinwalzstellen von Heizrohrkesseln) L. Schneider. *Die Eisenbahn-Werkstätte,* Vol. 41, June 20, 1933, pages 103-105; July 5, 1933, pages 114-115. Discusses leakages due to deformation of tube walls and extension of tubes under the influence of irregular heating of tubes and boiler shells as well as to unequal steam pressure. Magnitude of tube thrust and stressing of rolled joints in multitubular boilers. Means of reducing tube thrust. Data on adhesion of rolled joints. Effect of boiler incrustations. Suitable tube anchoring according to British, American and German patents. Supplement: Practical tests of Engel-Graz on tightness of 4 different tube anchorings on repeated heating and cooling cycles. WH (29)

Hot-Shortness of Austenitic Steels (Wärmesprodigkeit austenitischer Stähle) M. Schmidt & O. Jungwirth. *Archiv für das Eisenhüttenwesen,* Vol. 6, June 1933, pages 559-562. In tensile tests of nickel-chromium austenitic steels of varying carbon content, at temperatures between 650° and 1000° C., appreciably lower ductility was obtained in the range 650°-900° C. than at room temperature. This was attributed to carbide precipitation. The lowered ductility appeared to have no adverse effect on the forgeability. Specimens tested after slow cooling to the range 650°-870° C. from 1120° C. showed no reduction in ductility; apparently no precipitation occurred during cooling from 1120° C. to the testing temperature. In the 18-8 austenitic specimens Ta and to a lesser extent Al appeared to shift the low ductile range to higher temperatures. SE (29)

Mechanical Properties at Minus 40 Degrees of Metals Used in Aircraft Construction. J. B. Johnson & Ture Oberg. *Metals & Alloys,* Vol. 4, Mar. 1933, pages 25-30. Aircraft metal factor of safety of mechanical properties is usually based on tests at normal temperature of about 25° C. To test the safety of this procedure a cold chamber was installed at Wright Field. Temperature of this chamber averages near —40° C. (equivalent to 30,000 ft. altitude), and is fairly constant. Experiments were performed on Fe, Al and Mg alloys for tensile strength, yield strength, impact test and modulus of elasticity at both normal temperature and —40° C. Temperature of specimens was tested under load and found to be appreciably warmer than room or atmospheric temperatures. Tensile strengths of iron alloys showed an increase at the lower temperature and the increase approached 50% in annealed corrosion resistant steel. Impact values of cold worked low C steel are much lower at —40° C. but low C corrosion resistant steel is unaffected. Modulus of elasticity on all alloys tested was unchanged, except for corrosion resistant steel which showed an increase. While the notch test usually lowers fatigue limit at normal temperature the effect on Al and Mg alloys was not accentuated at —40° C. and some steels resisted this effect. Resistance to fatigue or sudden load is not affected by low temperature except on cold rolled C steel. Hence the designer is safe in using allowable stresses determined by testing material at normal temperatures. WLC (29)

Temperature Coefficient of the Moduli of Metals and Alloys Used as Elastic Elements. G. H. Keulegan & M. R. Houseman. *Bureau of Standards Journal of Research,* Vol. 10, Mar. 1933, pages 289-320. In continuation of work reported in N. A. C. A. Technical Report No. 358, temperature coefficients of the modulus of rigidity and of Young's modulus of elasticity of 31 metals and alloys have been determined in temperature range —50° to +50° C. These were selected on the basis of their possible use as elastic elements for aircraft and other instruments. In most cases temperature coefficients were determined with metal in condition of heat treatment or cold work most suitable for its use as an elastic element and also in annealed condition. Coefficient of each modulus at 0° C., ratio of coefficient at +25° C. to that at —25° C., composition and heat treatment or cold work are given for each sample. Temperature coefficient of Poisson's ratio and significance of difference in 2 coefficients for a given material are discussed. WAT (29)

REDUCTION METALLURGY (31)

Experiments in Metal Extraction from Slags Containing Zinc. V. A. Vanyukov & G. V. Ruikov. *Tsvetnuie Metallui,* No. 4, Apr. 1932, pages 467-492 (In Russian). Adaptability of gas process to treatment of slags containing Zn and other metals was investigated using 2 slags, one containing 17.39% Zn, 3.02% Pb, 6.08% Sn, 0.46% Sb, 8.39% Cu, 0.39% Ni, 38.2% SiO_2, 1.52% CaO and 23.2% $Fe_2O_3 + Al_2O_3$, and the other 17.7% Zn, 4.46% Pb, 1.11% Sn, 0.29% Sb, 5.39% Cu, 0.44% Ni, 30.14% SiO_2, 4.09% CaO, and 31.8% $Fe_2O_3 + Al_2O_3$. Reduction of metals from suspended powdered slags with gas can be applied economically to extraction of Zn, Pb, and part of Sn as oxides. Cu, Sn and Ni are obtained in a melt easily separable from the slag. Strongly siliceous residual slags can be utilized. The melt containing 70-75% Cu and 20% Sn can be treated in a converter to produce blister Cu, or Cu-Ni anodes, and Sn oxide. The average recovery is 96-98% for Zn, 94-96% for Pb, 85-90% for Cu and 80-85% for Sn. Consumption of solid fuel and reducers (coal, coke) is about 25-30% of weight of slag charge, and can be substituted partly by producer gas. Oil consumption for maintaining the temperature when solid reducers are used is about 10% of the slag weight. No oil is required when gas is used. To keep charge in furnace and to prevent it from being carried over with oxides it was necessary to introduce low melting fluxes. With low melting charge fluxes are unnecessary. In zone of flux rain, reducing atmosphere should be maintained. Outside of this zone, additional air is introduced for oxidizing the metals and the gases (CO and H_2). The oxide mixture can be used for manufacture of lithopone and babbitt metals. BND (31)

Reduction and Refining of Lead in 1931. *Mining & Metallurgy,* Vol. 13, Jan. 1932, pages 33-34. Steady advance was made in art of Pb smelting and refining. Natural gas is being used for Anaconda Copper Mining Co. Kroll-Bittertan de-bismuthizing process has been further developed by American Smelting & Refining Co. New plant of U. S. Refining Co. was put into operation. VSP (31)

A New Process in the Metallurgy of Lead. F. M. Loskutov. *Tsvetnuie Metallui,* No. 2, Feb. 1932, pages 162-176. In roasting rich Pb concentrate, granulated slag from Pb smelting furnaces is substituted for fluxes, which results in better elimination of S in roasting and better sintering. Sintered material thus prepared is ready for reduction smelting and does not require use of any additional fluxes. Repeated continuous use of same slag eliminates loss of Pb in slag. It is claimed that the new process gives easier control of charge composition, eliminates loss through oxidation, reduces fuel consumption in smelting, and results in great reduction of production costs. Process was developed in, and has been in use since 1931. BND (31)

Reduction and Refining of Copper During 1931. *Mining & Metallurgy,* Vol. 13, Jan. 1932, pages 30-32. Progress in Cu refining in 1931 has not been revolutionary. Outstanding improvement in accessory equipment in U. S. has been adoption of natural gas as fuel. Treating of finely ground concentrates of higher grade continues to be solved successfully. Refractories for furnace construction received considerable attention. Segregation process may have a bearing on leaching in the future. Available refining capacity of world continues to increase. VSP (31)

Slags in Copper Ore Smelting. L. I. Cheluishev. *Tsvetnuie Metallui,* No. 3, Mar. 1932, pages 352-357. Discusses chemistry of slags and their use for construction purposes. BND (31)

Copper Refining in Lancashire. *Electrical Review,* Vol. 112, June 9, 1933, pages 803-804. Describes plant and process of British Copper Refiners, Ltd., Prescot, Eng., for fire refining, without electrolysis of blister Cu received from Rhodesia. Refined Cu has purity of 99.93-99.95%. Reverberatory furnace is charged with maximum of 175 tons of metal. Dimensions of bath are approximately 30′ × 13′ × 2′. Pulverized coal is used as fuel. Air at 18 lb./in.² is used for blowing. Cycle of operations extends over about 24 hrs., divided into charging, 2 hrs.; melting, 9 hrs.; blowing, 5 hrs.; poling, 3-4 hrs.; and casting, 3-4 hrs. MS (31)

NON-METALLIC COATINGS FOR METALS & ALLOYS (32)

Internal Coatings for Boilers and Their Testing (Über Innenanstrichschutzmittel für Dampfkessel und ihre Prüfung) G. Ammer & H. H. Mueller-Neuglück. *Die Wärme,* Vol. 56, Apr. 1, 1933, pages 195-199; Apr. 8, 1933, pages 215-222. Various testing methods for internal boiler coatings are reviewed and a novel boiling test in a pressure vessel at 60 atmospheres is emphasized. Data gained with this autoclave on tests on a large scale are graphically presented referring to 21 different coatings on the German market. Corrosion and incrustations in high pressure boilers can however be only counteracted by careful softening of the feed water. EF (32)

How to Use Pearl Essence Lacquers for Finishing Automobiles. Marcus L. Freud. *Industrial Finishing,* Vol. 8, Mar. 1932, pages 56, 58. A description of the proper procedure for applying pearl essence lacquer to automobile bodies. JN (32)

Examination of New Pipe Coverings Exposed to the Influence of Electric Currents, Low Temperatures and Vibration Stresses. W. Beck. *Gas Engineer,* Institution Special Number, June 1933, pages 327-332; discussion, page 333; abstract, *Electrical Review,* Vol. 112, June 23, 1933, page 902. Speaker before the 70th Annual General Meeting of the Institution of Gas Engineers, May/June 1933, Liverpool, reports on experiments carried out in the Kaiser Wilhelm Institut für physikalische Chemie und Elektrochemie, Berlin-Dahlem. The laboratory tests include turned and unmachined Fe pipes provided with the coating material and hooked up as the anode in an electric cell buried in moist sand. Duplicate measurements showed satisfactory agreement. The results gained on unprotected pipe, cotton bandage, rubber paraffin, chloro-vulcanite are tabulated and given in 5 charts which show time/current density curves. The materials employed were of German, British, Dutch and American origin. While the resistance increased from 164 ohms to 345 ohms after 113 days on the unprotected pipe, the initial resistance of ∞ ohms dropped to 4600, 4300, 470 for cotton bandage, rubber paraffin and chloro-vulcanite respectively. In the discussion, the European method of isolation is pointed out in comparison to the American method of tackling protection against electrolytic action by electrical drainage, joining pipe or cable to a negative return. MS + WH (32)

Finishing Graham Cars in Pearl Essence. William G. Haarz. *Industrial Finishing,* Vol. 8, Sept. 1932, pages 11-12. The process for applying pearl essence lacquer to automobile bodies is described as well as the method for refinishing damaged spots in the same material. JN (32)

Cement and Concrete as Rust Preventives (Zement und Beton als Rostschutzmittel) Gruen. *Oberflächentechnik,* Vol. 9, Nov. 1, 1932, page 222. See *Metals & Alloys,* Vol. 4, June 1933, page MA 199. Ha (32)

Protective Coatings for Underground Pipe Lines (Schutzüberzüge für unterirdische Rohrleitungen) H. A. Gardner. *Farben-Zeitung,* Vol. 37, July 23, 1932, pages 1483-1484. Principal 13 pre-requisites which must be met with by underground pipe coatings are listed, the testing methods of the American Petroleum Institute are described, and 5 different groups of coating methods are dealt with. Author developed an accelerated test cutting down the testing time from 3 years to 4 months. The corrosion test is based on wetting with 1/10% HCl + 1% salt solutions in a 3 days cycle. Detailed information is given on the 10 most successful coatings which should comprize 90% binding agent, 75% wood oil + 25% vegetable or animal oil boiled down with 1% metal oxide dryer and 10% Zn chromate. A lasting corrosion protection must include an anti-rust grounding. The best passifying effects are secured with red lead, Zn-oxide-Zn-chromate, lead sulphate. The primer should be prepared with wood oil containing varnishes as binding agent instead of crude linseed oil. An additional bitumen coating and an impregnated cotton spiral on top of it warrant a preservation of further 20 years. EF (32)

Spotting of Light Paint Coatings by Metals (Fleckenbildung durch Metalle auf hellen Fassadenanstrichen) H. A. Gardner. *Farben-Zeitung,* Vol. 37, July 2, 1932, page 1389. Corrosion products from Fe and Cu are often carried away by rain and dew and discolor paint in their path. Exposed metals should be provided with a varnish or paint coating. Standard linseed oil paint can be applied to metal roofings, screens and gratings. Cu-sheets, the natural color of which is intended to be preserved, demand a fast weather-resistant varnish which might be dyed. Stains of paint coatings can be removed by oxalic acid (10%). Discoloration due to Cu may be removed by citric acid, diluted HCl, strong acetic acid or pumice soap. EF (32)

Temporary Rust Preventatives. H. N. Bassett. *Mechanical World & Engineering Record,* Vol. 93, July 7, 1933, pages 644-645. Requirements of a medium for temporary protection are discussed. Greases of the ordinary kind have to be melted before application and sometimes cause slight corrosion on brass or bronze. After mentioning the drawbacks of petroleum jelly and mineral oils, lanoline is called the most suitable coating and preparations containing it are discussed. Experiments have shown that coatings of lanoline can be relied upon to last for a year or more in quite difficult conditions. A solution of 50% white spirit and 50% lanoline by weight makes a satisfactory protective medium. Better results are obtainable from a non-inflammable solution of about 40% lanoline and trichlorethyl. Kz (32)

Refrigerator Finishing. G. Klinkenstien. *Industrial Finishing,* Vol. 8, June 1932, pages 32, 34, 36. Abstract of paper presented before Paint and Varnish Division, American Chemical Society, New Orleans, Mar. 29, 1932. A suitable refrigerator finish must offer maximum resistance to abrasion, impact and humidity conditions, be unaffected by prolonged contact with butter, oils and greases or accidental contact with SO_2 fumes, and must not become brittle or discolored on aging. Best results were obtained by a white baking enamel, baked 1-1½ hrs. at 300° F., followed by 2 coats of special white lacquer enamel. JN (32)

Oven Temperatures Affect Finishes. W. W. King. *Industrial Finishing,* Vol. 9, Nov. 1932, pages 31-32, 34. Brief description of author's method for determining actual temperature of lacquered tin plate in its passage through baking oven. For efficient baking, author recommends calibration of ovens at three nominal temperatures by this method and adjustment of drafts and flames according to charts obtained. JN (32)

Criticism of Accelerated Testing of Rust Preventing Paints (Kritisches zur Kurzprüfung von Rostschutzfarben) F. J. Peters. *Die Metallbörse,* Vol. 22, June 15, 1932, pages 753-754; June 22, 1932, pages 785-786; June 29, 1932, page 818; July 6, 1932, pages 850-851. Writer differentiates between "accelerated" (Kurzprüfung) and "abbreviated" test (abgekürzte Prüfung). The commonly known advantages and disadvantages of the accelerated testing methods of anti-rust paint coatings are summarized and attention is focussed on some further drawbacks not yet dealt with in literature: (1) the aim of this kind of testing method is to decide which are the worst coatings, but the interest of industry is which is the most stable coating. (2) The accelerated test does not establish which of the destructive influences is the most powerful one. (3) The latter are employed in an exaggerated manner except one destructive agent, moisture. Water permeability is however one of the paramount criteria of paint stability. Data from the Chemisch-Technische Reichsanstalt are presented. (4) Accelerated tests yield either the same or opposite results, i.e. about 70% of all data are identical which means every third rust coating is erroneously judged. (5) The development in chemical and physical regard during the course of several months is entirely neglected. The problems involved in abbreviated and outdoor testing are dealt with, many of which can be taken into consideration with reference to corrosion tests of metals. Method developed in Chemisch Technische Reichsanstalt is described. EF (32)

Lacquer Finishing Traffic Signal Arms. RAY C. MARTIN. *Industrial Finishing,* Vol. 8, May 1932, pages 42, 44. Metal signal arm indicators for use in city traffic control are cleaned with chemicals or solvents, sprayed with a lacquer product, coated with enamels and finally stenciled "STOP" and "GO." JN (32)

Black Protective Coatings and Their Solvents in Hygienic Regard. (Schwarze Schutzanstriche und deren Lösungsmittel in hygienischer Beziehung) P. MECKE. *Gesundheitsingenieur,* Vol. 55, Apr. 16, 1932, pages 188-190. Reports on experiments with white mice to determine effect of black protective coatings and their solvents respectively on the organism. Coatings containing benzol, phenol or even tar should not be used for vessels containing drinking water or liquids destined for food. EF (32)

Fine Metal Furniture Finishing. W. V. MORROW. *Industrial Finishing,* Vol. 8, Oct. 1932, pages 26, 28-30. The requirements for a suitable finish and the operations involved in cleaning and finishing high quality welded steel furniture are described in detail. JN (32)

Finishing Electric Light Fixtures. J. W. LONDON. *Industrial Finishing,* Vol. 8, Mar. 1932, pages 19-20, 22. Details are given for applying various types of finishes on metal electric fixtures for the home. JN (32)

ORE CONCENTRATION (33)
Flotation (33c)

Recovery by Flotation of Mineral Particles of Colloidal Size. A. M. GAUDIN & PLATO MALOZEMOFF. *Journal of Physical Chemistry,* Vol. 37, May 1933, pages 597-606. It is believed that non-flotation of colloidal sulphide mineral particles is due to their being unable to come in contact with gas bubbles because of fine size and state of dispersion. Selective flocculation makes flotation of colloidal mineral more complete and easier. Owing to the possibility of mutual flocculation of fine gangue and sulphide minerals, it is necessary, in order to effect selective flocculation, to act on the mineral particles at the time they are produced in grinding. Flotation of colloidal sulphide mineral particles may be accomplished successfully by using certain heteropolar sulphur-bearing organic substances as reagents. These agents effect selective flocculation of the sulphide mineral particles. 14 references. EF (33c)

The Physical Chemistry of Flotation. I. The Significance of Contact Angle in Flotation. I. W. WARK. *Journal of Physical Chemistry,* Vol. 37, May 1933, pages 623-644. Some problems awaiting solution before an explanation of the physical nature and behavior of froth systems can be obtained are outlined. Some of the physical and chemical principles underlying the adhesion between a bubble of air and a single solid particle, considered as the basis of the flotation process, are discussed.. EF (33c)

The Physical Chemistry of Flotation III. The Relationship between Contact Angle and the Constitution of the Collector. ELSIE EVELYN WARK & IAN WILLIAM WARK. *Journal of Physical Chemistry,* Vol. 37, June 1933, pages 805-814. The angles of contact due to the following flotation "collectors" have been investigated: xanthate, mercaptan, dithiocarbamate, dithiophosphate, tritiocarbonate, and monothiocarbonate. When contact occurs, the angle at the line of contact air-solid-solution is dependent only upon the nonpolar group of the adsorbed collector and independent of the nature of the solid, of the polar or anchoring group of the collector, and of the concentration of the collector. Whether adsorption of the collector occurs at a mineral or metal surface is related to the solubility of the corresponding metal salt of the collector. EF (33c)

The Physical Chemistry of Flotation. IV. A Criticism of Ostwald's Theory of Flotation. I. W. WARK & A. B. COX. *Journal of Physical Chemistry,* Vol. 37, June 1933, pages 815-819. Ostwald's theory of adlineation, i.e., that only a ring of the collector is necessary for flotation, the location of this ring being the air-water-mineral line of contact is contradicted by the writers who hold that for soluble collectors a substantially complete unimolecular film is adsorbed by the surface of the mineral, and that for oleaginous collectors a continuous thin film spreads over the surface. In practice, quantities of reagents must be added enormously in excess of those required to give an adlineation ring. Considering the turbulent condition of the flotation pulp it is doubtful whether a ring of collector of the type suggested by Ostwald could lead to a sufficiently stable contact between air and mineral. If the adlineation theory were correct, the angle of contact would be independent both of the addition of a collector and of its nature. This is contrary to experience. The authors prove on diphenyl and paraffin wax that Ostwald's theory cannot have universal application in accounting for the mechanism of flotation. Indeed, Ostwald does not use the "adlineation" theory for oleaginous collectors, but propounds the theory of "laminar" flotation. It is the writer's view that the essential function of the frother is to stabilize the large air-water interface necessary for froth flotation. During the formation of the air-mineral aggregate the frother is squeezed from the surface of the bubble, and air then makes direct contact with the air-avid collector film. This collector film on the mineral surface may be an orientated adsorbed unimolecular layer, as in the case of soluble collectors, or a more discrete film of insoluble collector as in the case of oils. EF (33c)

Chemical Reagents for Flotation (Chemische Hilfsmittel der Schwimmaufbereitung) A. KATHE. *Die Metallbörse,* Vol. 23, Apr. 15, 1933, pages 477-478; May 20, 1933, pages 638-639. The different roles which chemicals play in the flotation process are discussed, data on the consumption of collectors and frothers in the U. S. are presented and more or less complete information is given on the following chemicals used: alkalies, caustic potash, phosphates, sulphur dioxide and sulphites, H_2S, Ag-salts, Hg-salts, $CuSO_4$, colloidal SiO_2, $Cr(NO_3)_3$. Cl and Br, alkaline and earth alkaline chlorides, Fe^{++} and Fe^{+++} cyanides, fluosilicic acid, CO_2, S, sulphides, Na-tartrate, Zn-compounds, borax, Fe-vitriol, Aerofloat, Barrel oil, Sedax, Chapopote, Eureka, Flotagen, Pensacola, Raconit, T-A, T-T, and X-Y mixtures, Voltole, Y and Z reagent, colloids, gallates, glue-like substances, xanthates, thio-derivatives, organic Se compounds, turpentine oil, tar and tar oils, shale oil, peptones and saponines, hydro-carbons, eucalyptus oil, quinine salts, and soaps. EF (33c)

Flotation Properties of Pine Oils. N. A. ALEINIKOV. *Tzvetnuie Metallui,* No. 3, Mar. 1932, pages 299-319 (In Russian). Second Report from the Laboratory of Flotation Reagents of the State Institute of Non-ferrous Metals (Russia). (See *Tzvetnuie Metallui,* No. 6, 1930). Preparation of flotation oils from certain raw materials is described. Certain general relations which should be taken into account in testing various pine oils in flotation are pointed out. The influence of terpene alcohol content of oils on flotation of sulphide ores was determined. Low boiling carbohydrates exert no appreciable influence on flotation, while the high boiling point carbohydrates decrease the stability of dispersed air and the speed of flotation. BND (33c)

Physico-chemical Investigation of Solid Oxidized Paraffin as a New Flotation Reagent. V. Practical Applications of Physico-chemical Studies of Flotation Process. M. E. LIPITZ, P. A. RHEBINDER & M. M. RIMSKAYA. *Tzvetnuie Metallui,* No. 3, Mar. 1932, pages 288-298 (In Russian). Fifth of a series of reports from the Colloidal Laboratory of the Institute of Non-ferrous Metals. (See *Tzvetnuie Metallui,* Nos. 5, 7, 8 and 11, 1931). The activity of flotation reagents, as judged by their influence on selective wetting, increases with the transition from lower to high homologues. The influence on the selective wetting of "solid oxidized" paraffin, i. e., mixtures of solid higher fatty acids, obtained by oxidising paraffin with air at 160° was investigated thoroughly. The reagent was active and possessed good ability for selective flotation, particularly of oxidized ores. BND (33c)

Soluble Metal Xanthates and Their Effect on Differential Flotation. S. POWER WARREN. *Canadian Mining & Metallurgical Bulletin* No. 251, Mar. 1933, pages 186-222. Xanthates of heavy metals differ greatly from one another in their solubility in various flotation reagents that are in common use and in others that might be used. Chemical conditions in a mill pulp which favor precipitation of xanthate of metal contained in a mineral, will cause mineral to become attached to the gas bubble more firmly than the original sulphide mineral, and consequently will accelerate its flotation rate; conditions which favor solution of a xanthate of metal contained in a mineral will prevent acceleration of natural flotation rate of original sulphide and allow room on surface of this mineral for other chemical reactions which will retard flotation rate of original sulphide. Common practice in ordinary differential flotation of galena-chalcopyrite-sphalerite-pyrite can be explained by solubilities of metal xanthates. A method for separation of pentlandite-chalcopyrite-pyrrhotite by flotation outlined from purely chemical data was confirmed by subsequent flotation tests. Failure to float Au with chalcopyrite in ordinary practical separation is explained by solubility of Au xanthate in cyanide. A method for separation of pyrite from Au-chalcopyrite was outlined from chemical data and confirmed by subsequent flotation tests. Chemical data indicate that pentlandite can be floated ahead of chalcopyrite or vice versa. This was confirmed by tests. Ores that have been exposed to influence of oxidation or secondary precipitation do not respond to treatment outlined as well as do clean unaltered minerals. AHE (33c)

Flotation in the Treatment of Gold Ores. ROBERT L. KIDD. *Mining & Metallurgy,* Vol. 13, Sept. 1932, pages 405-406. The flotation of free Au from the following ores is discussed: (1) Quartzite containing 0.26 oz. Au/ton in which no base metals were present, (2) sulphide ore (2.04 oz. Au, 1.31 oz. Ag) containing pyrite and free Au, and (3) oxidized ore (1.10 oz. Au, 0.70 oz. Ag). Tests showed that oxidized and Au-bearing quartzite ores were more easily treated and higher recoveries obtained than with sulphide ore when straight amalgamation, cyanidation or flotation was used. Conclusions: (1) Bright free Au is floated easily regardless of presence of pyrite; (2) tarnished Au may be floated after surface has been partially altered or worn away by grinding; (3) a high grade Au or Au-Ag concentrate may be produced by combined flotation and gravity concentration. VSP (33c)

Milling Methods and Costs at the Concentrator of the Premier Gold Mining Co., Ltd., Premier, B. C., Canada. D. L. PITT, W. J. ASSELSTINE & D. L. COULTER. *United States Bureau of Mines, Information Circular* No. 6742, Aug. 1933, 18 pages. A Au-Ag ore assaying (1931) Au 0.305 and Ag 5.93 oz./ton gave a 93.35% recovery of Au and an 86.29% recovery of Ag in a concentrate assaying Au 2.41 and Ag 43.17 oz./ton by flotation using Na_2CO_3 0.03, NaCN 0.01 and Aerofloat 0.27 lb./ton at a total cost of $1.067 ton. AHE (33c)

Milling Practice at Premier. W. J. ASSELSTINE & D. L. COULTER. *Transactions Canadian Institute of Mining & Metallurgy,* 1933 (in *Canadian Mining & Metallurgical Bulletin* No. 250, Feb. 1933) pages 28-50. A Au-Ag ore is concentrated by flotation. In 1931, reagents were Na_2CO_3 0.030, NaCN 0.012 and Aerofloat 0.280 lb./ton; heads assayed Au 0.305, Ag 5.93 oz./ton; concentrates assayed Au 2.41, Ag 43.17 oz./ton; recoveries were Au 93.35, Ag 86.29%; costs were $1.067/ton of ore. The flow sheet employs a stage grinding-flotation-classification system, which gives a differential grinding effect whereby the heavier sulphide particles are ground much finer than the gangue. The Premier cell, operating with a cone classifier, was a development of this scheme. This cell is of the cascade type and was developed primarily for use between the primary grinding and regrind circuits, and also between the regrind circuits and their respective cone classifiers. These cells remove a coarse concentrate as soon as grinding has reached the stage where flotation is possible. Details are given. AHE (33c)

Amalgamation-Flotation of Gold Ore. STEWART CAMPBELL. *Engineering & Mining Journal,* Vol. 134, May 1933, pages 188-190. Description of metallurgical operations at Boise-Rochester mill of St. Joseph Lead Co. in Idaho, is given with flowsheet and average assays of mill feed and products. Au is associated with arsenopyrite and argentite; 70% is recovered as bullion and remainder as concentrate. WHB (33c)

The Treatment of a Gold-Copper Ore from Gogama, Ontario. ALEX. K. ANDERSON. *Canada Department of Mines, Mines Branch, Report* No. 728, 1932, pages 85-87. A quartz ore assaying Au 6.21 oz. and Ag 4.12 oz./ton, Cu 3.82% and As 0.05% gave 79% Au recovery by amalgamation and 17% more in a flotation concentrate containing 98% of the Cu. AHE (33c)

Advance in Flotation. R. E. BARTHELEMY. *Engineering & Mining Journal,* Vol. 134, July 1933, pages 280-281. Sphalerite and Cu minerals have been separated by flotation. During grinding ore is treated with a complex inorganic salt. Dithiophosphate is used as collector and sphalerite is floated with no appreciable amount of Cu; then Cu is floated with xanthate as collector. WHB (33c)

Flotation of Cu-Zn Ores (Flotation von Kupfer-Zinkerzen) W. G. HUBBER. *Die Metallbörse,* Vol. 22, June 25, 1932, page 803. The practice at the new Canadian Amulet mine treating complex Cu-Fe-Zn ore by selective flotation is fully outlined. (See also Canadian Mining Metallurgical Bulletin No. 226, 1931, pages 295-306.) EF (33c)

Milling Practice at Mount Lyell. MAXWELL E. PLAYFORD. *Proceedings Australasian Institute of Mining & Metallurgy,* No. 88, Dec. 31, 1932, pages 383-406. Ore from 4 mines is blended. The principal sulphide minerals are chalcopyrite, bornite and pyrite. The flow sheet and equipment are described in detail. The ore (3.2% Cu, 11.6% Fe) is floated with lime 6.0, Aerofloat 0.55 and cyanide 0.12 lb./ton to give a concentrate of Cu 21.0, Fe 30.5, and insoluble 10.7% with a recovery of 94.9%. Total costs are 50.05 d./ton. AHE (33c)

Flotation Tests on a Sample of High-Grade Cobalt Ore from Kenora Prospectors and Miners, Limited, Toronto, Ontario. J. S. GODARD. *Canada Department of Mines, Mines Branch, Report* No. 728, 1932, pages 75-76. An ore containing 15.81% Co with pyrite and Zn blende was floated to give 97% recovery in a concentrate carrying 24.77% Co. A 29.5% concentrate was obtained at 85% recovery. AHE (33c)

Concentration of Akdjal Arsenic-Bearing Sands. V. I. TRUSHLEVICH. *Tzvetnuie Metallui,* No. 4, Apr. 1932, pages 492-505 (In Russian). Part of a larger study of extraction of As concentrates from various residual products from the treatment of Au ores. The sand used in the experiments contained 5.77% As and consisted of small grains of pyrite and arsenopyrite with some quartz and feldspars. Table concentration did not give desired results. Flotation gave 90% recovery using the following reagents in acidulated medium: T-T reagent with turpentine; T-T and xanthate; T-T, xanthate and pine oil. BND (33c)

Xanthates, Their Properties and Importance for Flotation. E. A. SHCHERBAKOVA. *Tzvetnuie Metallui,* Part I, **Synthetic Preparation of Xanthates,** No. 1, Jan. 1932, pages 6-22; Part II, **Flotation Tests of Xanthates,** No. 7-8, 1932, pages 43-65. This is a report on an extensive investigation of xanthates being conducted at the Laboratory of Flotation Reagents of the State Institute of Non-Ferrous Metals. The preparation of synthetic xanthates from various alcohols of Russian manufacture and their applicability to flotation are described. Purified xanthates, containing very small amounts of impurities, give better extraction and purer product than impure xanthates. Higher xanthates, even low-grade commercial products, showed considerable advantage in comparison to ethyl xanthate. Their use makes possible the reduction of the quantity of xanthates in flotation, and accelerates the process. Butyl xanthate can be substituted successfully for isoamyl xanthate. Of the higher xanthates, benzyl xanthate was the least active. BND (33c)

ADVERTISERS' INDEX

MANUFACTURERS' LITERATURE

Corrosion and Heat-Resisting Alloys

The Enduro 4-6% chromium steels are discussed in a new booklet from the Republic Steel Corporation, Central Alloy Division. These steels possess resistance to corrosion, acid attack and scaling at elevated temperatures and in addition can be rolled, formed, drawn, forged, welded or riveted into almost any shape. (79)

Wrought Iron Billets

The toughness of wrought iron resulting from the slag stringers distributed through it makes this material particularly suitable for certain uses in the railroad field according to a folder received from the A. M. Byers Company. Wrought iron forging billets meet the requirements of strength, toughness, fatigue resistance and uniformity of structure required in this type of service. (80)

Automatic Control Systems

Automatic control systems applicable to many types of installations, large or small, are illustrated in a folder put out by the Minneapolis-Honeywell Regulator Company. Savings as high as 35% in fuel economies have been effected in many cases by the use of automatic control. (81)

Oil-Hardening Tool Steel

"Carbomang," a new product of the Detroit Alloy Steel Company, is a high grade tool steel, cast to shape, for purposes where higher-priced alloy steel castings could not be afforded. A leaflet from the company gives detailed shop practice for users of Carbomang. (82)

Industrial Furnaces

Catalog No. 6 from the Bellevue Industrial Furnace Company lists and illustrates various sizes of their brass and aluminum melting and crucible heating furnaces and accessories designed to supply standard equipment for melting non-ferrous metals. They may be either gas or oil-fired. (83)

Corrosion-Resisting Steels

The Bethlehem Steel Company has issued their Catalog 127 which discusses in detail the nine grades of their Bethadur and the two grades of Bethalon, corrosion-resisting steels. The analysis, physical properties and a list of corrosive reagents to which the material is resistant are given in each case, together with suggested uses for each grade. (84)

Motor Drive for Board Drop Hammers

Bulletin No. 304 from the Erie Foundry Company states that motor drive for board drop hammers has been perfected in all sizes in which these hammers are available. Their type "M" two roll hammers and their four roll hammers are discussed in great detail. Diagrams and blue prints show the construction and operation. (85)

X-Ray Developing Tanks

Stoneware tanks are recommended for developing X-ray plates and films in Bulletin 304 from the U. S. Stoneware Company. Specifications and illustrations of types for various applications are given. These tanks will withstand the actions of acids, alkalies and chemicals, weak or strong, hot or cold. (86)

Refractories

Bulletin 25, Series A, from The Massillon Refractories Company, gives the physical properties of their Alumite "RI-43," a refractory material of high insulating value, light weight and low specific heat. (87)

Liquid Baths for Heat Treating

A convenient handbook prepared by the Research Staff of E. F. Houghton & Company discusses the operation of salt baths for tempering, normalizing, annealing and hardening of steel. It shows several actual furnace designs and gives many pointers on the efficient operation of salt bath furnaces. (88)

Machining Aluminum

The fundamental requirements and principles involved in the proper machining of aluminum are contained in a recent booklet from the Aluminum Company of America. The shapes of the tools for the various machining operations are given in detail together with a few remarks on the cutting lubricants to be used. (89)

Electrode for Welding Cast Iron

A leaflet from the Lincoln Electric Company discusses "Ferroweld," an electrode for welding cast iron. It has a steel core surrounded by a heavy flux coating providing a shielded arc and is produced in one size only, 1/8" in 14" lengths. (90)

Savings in Tool and Die Cost

Bulletin No. L-960 from the Leeds & Northrup Company discusses the new Hump method for hardening which brings under control the quench point, the rate of heating and the furnace atmosphere. Due to this triple control tools and dies are clean and normal in size, so that grinding or other refinishing to remove surface imperfections is unnecessary. (91)

Joint Sealing Compound

Bulletin No. 207 from Quigley Company, Inc., describes their "Q-Seal," a plastic, expansive compound for sealing joints in pipe lines and equipment carrying high pressure steam, oils, gasoline, acids, brine, etc. (92)

Nickel-Chromium Cast Iron

Super Manga Iron is discussed in a leaflet from the Robins Conveying Belt Company. It is recommended for use in crusher rolls, baffle plates, sand blast nozzles, etc., where it is said to offer 2 to 12 times longer life than other abrasion-resisting metals. (93)

Electric Furnace

The Bellis Heat Treating Company has issued a leaflet devoted to their electric furnaces and pointing out ten features which introduce new savings in heat treating. Several types of furnaces are illustrated. (94)

Bronze

The physical properties and applications of their "Superstrength" bronze are brought out in a folder from the Cramp Brass & Iron Foundries Company. The material in any grade, cast or forged, is readily machined and takes a high polish. It is non-magnetic, resists the erosive action of water and has a low coefficient of friction with steel. (95)

Burner Equipment

Several instances of economies resulting from the right burner equipment are described in a recent bulletin from the Surface Combustion Corporation. Operating data are given in each case. (96)

Furnaces

Catalog No. 346 from the W. S. Rockwell Company discusses their portable heat-treating and carburizing furnaces of the gas-fired, enclosed front type. They are suitable for annealing, hardening, normalizing, drawing, etc. (97)

Refractories

A folder sent out by The Chas. Taylor Sons Company recommends the "Tayco-C" refractories for service where strongly basic slags are present. Their fusion point is above cone 38 (3335°F.) and they are supplied in all standard and special shapes. (98)

Wire Nails

The Youngstown Sheet & Tube Company has issued their catalog No. 114 which is devoted to their wire nails and wire products. The company is also prepared to furnish catalogs on any of the other products manufactured by them. (99)

Insulation in the Foundry

Johns-Manville have issued a detailed pamphlet on the use of insulation in the foundry. A feature of the booklet is the appendix which contains tabulated data on refractory cement recommendations. These are classified according to industry. (100)

Electric Contact Controller

Bulletin 184 from The Foxboro Company discusses "Rotax," a new, positive-operating type of electric contact controller which can be applied to their instruments for controlling pressure, temperature, humidity and liquid level. It makes possible the use of electricity as the operating medium for control. (101)

Cost Saving Tools

A recent bulletin from The Carboloy Company has a four-fold purpose—to show their facilities for making all types of Carboloy tools, to show the types of tools made and in successful use, to summarize tool savings reported by users and to show that these tools are not just for special applications. (102)

Making Steel Machinable

A folder sent out by the Union Drawn Steel Company discusses the effects of cold drawing and annealing which improve the machining qualities of steel. The presence of certain elements and types of inclusions has been found to affect machinability adversely. Union Supercut and Union Hymo are recommended for a large group of applications. (103)

Copper Molybdenum Iron

A most attractive 64-page pamphlet has been received from the Republic Steel Corporation. It is entitled "The Path to Permanence" and is the story of their Toncan copper molybdenum iron, a ferrous metal that is easy to work, will render long service, and possesses the strength required in modern sheet metal practice. (104)

Recuperators

A recent folder from The Carborundum Company discusses the economies which can be obtained by the use of their recuperators,—reduction in fuel costs, reduction in time of heats, improved metal characteristics, increased pulverizer capacity and better combustion in the furnace. (105)

Electric Flow Meter

The Brown Instrument Company has just issued a folder which illustrates and briefly describes their electric flow meter. (106)

Furnaces

Bulletin No. 25 from the Standard Fuel Engineering Company is devoted to their high speed steel furnaces, which may be gas, oil or electric. Construction details and a table of sizes and dimensions are given. (107)

Grinding Equipment

The November-December issue of *Grits and Grinds*, published by Norton Company, announces five new grinding machines and an automatic electric sizing device. They are fully described and illustrated. (108)

Tubing

A folder from the Bundy Tubing Company describes the making of their solid, double-walled tubing. It is recommended for motor cars, electric refrigeration units and installations where tubing 1/8" to 5/8" O. D. is required. (109)

Insulating Brick

The Armstrong Cork & Insulation Company has compiled a booklet which gives the most practical methods of applying their insulating materials from the standpoints of initial cost, construction and efficiency. (110)

Stainless and Heat Resisting Alloy Steels

An exceptionally attractive booklet has been prepared and issued by the Committee on Stainless and Heat Resisting Steels of the Subsidiary Companies of the United States Steel Corporation. It discusses in detail their chromium and chromium-nickel alloy steels, giving the compositions of the various grades, their physical properties and fabrication as well as a list of the different environments to which each is resistant. The data are conveniently summarized in a table. (111)

Cause and Prevention of Rust

Bulletin No. 20 from the American Chemical Paint Company discusses the cause of rust, shows why many paints accelerate rust instead of preventing it and recommends the use of their A.C.P. Elastic Primer for the whole range of structural steel including bridges, storage tanks, and as a mill coat for structural steel and structural steel products. Directions for its use are given. (112)

Oil Hardening Steel

A folder from the Firth-Sterling Steel Company recommends their Invaro oil-hardening steel for dies, tools and similar purposes where the requirements indicate a steel that will show very little change, warpage or damage during heat treatment and which has great hardness and toughness. (113)

Temperature Controller

Bulletin No. 389 issued by The Bristol Company is devoted to their new pyrometer controller, Model 478, with self-contained mercury switches, for temperatures up to 3000° F. (114)

Heat Resisting Alloys

The Allegheny Steel Company has prepared a folder, Bulletin S-44, which gives the chemical composition and physical properties of their Allegheny 44, an alloy suitable for many applications demanding maximum heat resistance as well as facility of fabrication. (115)

METALS & ALLOYS, 330 West 42nd St., New York, N. Y.

I should like a copy of each piece of Manufacturers' Literature listed below.

....

Name..

Position.. Firm..

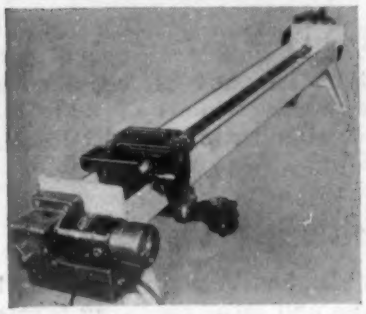
Street and Number..

City.. State..

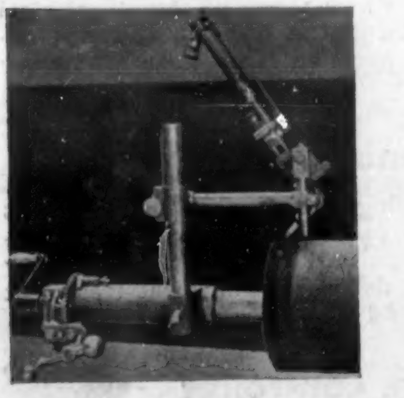
NEW MATERIALS and EQUIPMENT

New Cutting Machines

Straight-Line Cutting Machine. A new cutting machine, known as the Oxweld Straight-Line Cutting Machine, has been added to the Oxweld line of welding and cutting apparatus by The Linde Air Products Company, New York. This machine consists essentially of a steel channel supporting base, a means for moving the blowpipe, and adjustments for setting the blowpipe to cut bevels. Motion in 2 directions is possible: 45 in. longitudinally and 7¾ in. laterally. The machine can be furnished either with 2 traverse hand-wheels for hand operation, or with one hand-wheel and a 110-115-volt universal motor, either of which can be used by simply throwing a lever. The carriage is supported by a three-point suspension and an automatic catch disengages the carriage from the worm drive when the end of the track is reached. The working parts are completely protected from dirt by a metal cover assuring trouble-free operation. The machine has a linear speed range of up to about 33 in./min. depending on the gear ratio specified when ordering, and has a governor graduated in inches/minute for setting the speed. A reverse switch permits motion in either direction. A straight, steady cut is assured by roller springs that keep the gears in mesh and the carriage steady. The machine is light enough to be readily portable, but bolt-holes are provided for fastening it to a permanent support if this is desired.

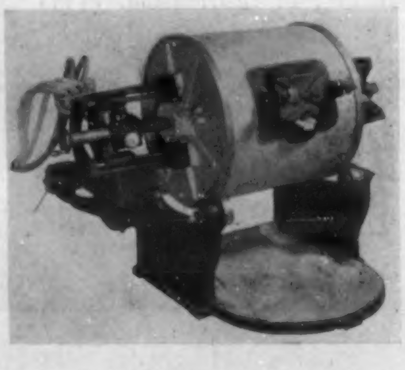


Oxweld Pipe-Cutting Machine. Another new cutting machine is known as the Oxweld Pipe-Cutting and Beveling Machine. It consists of a center rod with 3 spreading arms which press against the inner wall of the pipe, holding it in position, with an arm supporting a blowpipe that can be adjusted to the desired angle of the cut. The blowpipe and arm rotate without the use of a crank for quick centering of the device, and by means of a crank when doing actual cutting. This machine will take almost any hand-cutting blowpipe, is readily portable, and its operation is extremely simple. Once centered in the pipe, the operator merely turns the crank causing the blowpipe to rotate evenly around the pipe, making a clean machine-like cut. Wherever large quantities of pipe are to be cut and beveled, this machine will save time, money and trouble.



Small Rocking Electric Furnace

A new rocking electric furnace, of 25 to 100 pounds capacity, has been announced by the Detroit Electric Furnace Company, Detroit, Mich. The unit has been designed for either production or experimental melting of small lot runs of metals, such as iron, alloy steel, copper, brass, nickel, aluminum or precious metals. Except for size, the furnace is a faithful reproduction of the larger rocking electric furnaces and, it is claimed, will provide the speed, economy, and analysis control for which these furnaces are well known. "The keen interest of college engineering shops and laboratories in recent metallurgical developments has prompted the production of this small furnace as a part of our standard line. The requirements for speed in melting and shorter cycle heat treatment have given electric furnace metal an enormous advance, especially in the ferrous field," says E. L. Crosby, President. "Since we built the first of these furnaces, we have been told by many production and jobbing foundry superintendents and metallurgists that they wanted one of these units as a pilot implement to direct large production runs, as well as for quick special heats of 50 to 100 lbs." The furnace is completely equipped with transformer, control panel, switches, meters and rocking mechanism. It has a nominal electrical rating of 20 kilowatts and may be connected to any industrial power supply.



New Temperature and Pressure Controllers

Two new control instruments have been developed by the Foxboro Company, Foxboro, Mass. Their appearance is practically identical but one controls temperature, the other pressure. These 2 controllers will be found particularly useful where dependable control at a definite control point must be had. The dial and knob on the lower face of the controller permits adjustment of the temperature or pressure within the range of the instrument. The indicating gage above the adjusting knob shows the air pressure on the diaphragm motor of the control valve and also shows whether the valve is opening or closing. On the temperature controller, a two-inch dial type thermometer may be installed in place of the air gage. This thermometer is connected to the same bulb as the controller thus showing the temperature being maintained. The pressure controller may be equipped likewise with a high pressure indicating gage that shows the pressure being controlled. In either case, it is necessary to mount a valve motor air gage on the air line to the valve outside the case. These new controllers have a universal case that is designed so that it may be either flush or surface mounted. The one case serves for either style without change. The connection may be either top, bottom or back and the choice can be made on the job when the instrument is being set up. All working parts are integral with or mounted on a cast aluminum base. By removing the set screw in the setting knob and removing the 2 screws shown on the face of the instrument, the entire case can be removed, leaving the interior open to inspection.

Excess Temperature Cut-Out

Unlike excess temperature fuses, which protect only the heating equipment against excessive temperature, the excess temperature cut-out, manufactured by Hevi Duty Electric Co., Milwaukee, Wis., safeguards the charge against overheating. It may be set to cut-out a few degrees above the normal operating temperature of the heating equipment. It is adaptable to all types of heating equipment such as gas, oil, and electrically heated apparatus. A separate thermocouple located in the heating chamber operates the "Cut-Out" control relay. This relay is connected to form part of the main heating control circuit. An adjustable target is provided for setting the instrument at any desired kick-out temperature, which may be a few degrees beyond normal furnace temperatures. As soon as the temperature rises to the temperature of the target setting, the control circuit is opened, thereby shutting off the heat source. Failure of the thermocouple circuit of the "Cut-Out" opens the control circuit. Where no automatic control equipment is used, the "Cut-Out," in addition to its normal function, can be connected to flash a light or sound an alarm, or both, when excess temperature is reached.

23-11 Stainless Clad Steel

This new clad alloy, developed by Ingersoll Steel & Disc Co., Chicago, known as "IngOclad 23-11" is a two-ply stainless steel having a 20% stainless layer of 23% chrome, 11% nickel bonded to a back of mild carbon steel and produced under the Ingersoll Ingot Patented Process. In the development of the 23-11 clad material it is claimed that it will resist the forms of damaging corrosion attack encountered in both sulphite and sulphate pulp and paper mill applications to better advantage than the regular 18-8 series of alloys and at a price which is materailly less than the cost of comparable solid stainless steels. When welded with a 25-12 chrome nickel electrode this new alloy is equal or superior in corrosoin resistance to the special types of 18-8 stainless steels for most of the pulp and paper mill applications. The material is available in sheet or plate form in all commercial sizes. It is expected that this class of material will, on account of its initial low cost and special adaptation to the pulp and paper industry, usher in a new trend throughout the industry toward the wider use of corrosion resistant alloys to improve papers and add to the life of mill vats, tanks, machinery and equipment.